AN EDUCATIONAL
PSYCHOLOGY OF LEARNING

An Educational
Psychology of Learning

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An Educational
Psychology of Learning

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PREFACE

This book is for all students of education, graduate or undergraduate, who are interested in the *broad* educational significance of the psychology of learning. These students have a difficult task. If they are to get more than a picture of conflicting opinion, or of unrelated details, they need their attention directed to educationally important integrating concepts.

It is expected that the readers of this book, like the writer's graduate students, will vary a great deal as to psychological background. Therefore, an effort has been made to serve both those who have had many courses and those who have had few or none. The design is to stimulate the more advanced students to make a critical evaluation of what they have learned, and to encourage them to integrate their somewhat compartmentalized background into a more coherent and usable pattern. Those who are practically beginners in psychology will need to supplement their reading of this book in many directions. For them the book will supply an orientation and a frame of reference for supplementary and later study. The book is not encyclopedic. It includes some review of elementary course content for the sake of emphasis, but in the main the effort has been rather to supplement the existing literature. Nothing is included except as it is considered to be of vital importance in education.

The author is convinced that if a psychology of learning is to be used effectively in education it must be well integrated, and integrated around the needs of students of education. The author is also convinced that descriptions of attempts to achieve such an integration are much needed. This is his justification for writing.

Credit has not been given to all the writers who have expressed the thoughts of which use has been made. Many other good references could have been listed, but no attempt was made to do more than to introduce students to the literature.

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J. W. TILTON

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PART I

AN INTRODUCTION TO LEARNING THEORY

UNFORTUNATELY opinion is not unanimous as to the nature of the learning process. This complicates the reader's problem, and the writer's task. Confronted by differences of opinion the reader needs first to get a better idea of the problem which he faces. Why are there differences of opinion? What are the main issues? On what grounds may he take a tentative position? These are the questions to which Part I is addressed. Chapter one describes the general problem and suggests a frame of reference. Chapters two, three, and four are descriptions of the three issues in the theory of learning which are educationally most important.

CHAPTER I

THE GENERAL PROBLEM

Variety in the Explanation of Learning
What Should the Students Do?
Eclecticism?
Reasons for Differences
Educational Usefulness Must Be the Criterion
The Student's Frame of Reference
Summary

Variety in the Explanation of Learning

From the reading of only one elementary text one might easily get the impression that there is general agreement among psychologists as to the nature of the learning process. Wide reading reveals a great diversity.[1] Learning is variously described as synonymous with growth or with maturation; as a matter of the reinforcing or of the rewarding of responses; as the result of chance success; or as an insightful process. The description may portray learning as essentially a process of abstraction, adjustment, analysis, assimilation, association, conditioning, configuration, connection forming, cue reduction, generalization, habit formation, integration, the organization of experience, the reorganization of experience, or of problem solving.

Some of the factors which are thought to play an important part in determining the efficiency of the learning process are variously listed as annoyance, aspiration, availability of response, barriers, belongingness, contiguity, emphasis, exercise, felt needs, field properties, figure, frequency, goal reduction, identifiability of stimulus, intensity, interest, motivation, pain, pleasure, practice, punishment, purpose, readiness, recency, reward, satisfaction, set, similarity, valences, and vectors. But those stressed by one writer may receive no mention by another.

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[1] Melton, A. W., "Learning," *Annual Review of Psychology*, 1950, Vol. 1, pp. 9–30.

According to one text, "any one who has gone through the research or experimental literature on learning is pretty sure to come out with a belief that all our efforts thus far have resulted in little short of chaos." [2] Were the situation much less confusing it would still pose a difficult problem.

What Should the Student Do?

For some time to come the student of education will find differences of opinion as to the nature of the learning process. What is he to do? He is inclined to stop at this point and say, "If the psychologists can't agree, what's the use of *my* working at it?" But being an education student he cannot postpone a consideration of the learning process. The learning process is his business. Either he is already directing learning or he is about to direct it. He is using or will use a psychology of learning. He must therefore examine the facts and the opinions and evaluate them, for, tentative though it may be, the choice should be a considered judgment.

The easiest thing to do is to find the writer whose description measures up best according to the student's standards. As a first step in this direction, the student would do well to read Hilgard's review of the situation.[3] Hilgard devotes a chapter each to Thorndike, Guthrie, Hull, Skinner, Lewin, Wheeler, and Tolman, and describes the theories of several others.

The student who finds the differences most confusing will be better satisfied if, having found what he considers to be the best exposition, he confines his further reading to the writings of this author. The tougher-minded student will persist in his reading until he has reduced the differences to some order. Certain resemblances or schools of thought will soon be apparent. McConnell, in planning a yearbook on learning for the National Society for the Study of Education, thought that the best way to help the student was to present learning theory as being of three types: conditioning, connection forming, and field theory. He asked Guthrie and Hull each to write a chapter to illustrate the first, Sandiford and Gates each a chapter on connectionism, and Hartmann and Lewin each a chapter on field theory.

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[2] From Stoddard, G. D., and Wellman, Beth L., *Child Psychology*, New York, Macmillan, 1938, p. 183, by permission of the publishers.

[3] Hilgard, E. R., *Theories of Learning*, New York, Appleton-Century-Crofts, 1948.

Eclecticism?

But the problem is not confined to two possibilities, choosing the thought of one man or choosing the thought of one school. There is the possibility of choosing from a variety of sources. Hilgard[4] said in his preface that he approached his task on the assumption "that there must be something which each of them can teach us," and he presented his own theory as his final chapter. McConnell, in a chapter of his own, following the six *Yearbook* chapters referred to above, gave his own integrating exposition of learning theory.

No one should hesitate to be eclectic in his thinking. In fact, it would be impossible to avoid eclecticism, were it desirable to do so. The best we could do would be to hold eclecticism to a minimum. Exposed to many influences as we are, one cannot point to one source and say "that is the full and single source of my thinking." The thinking which we find admirable for its internal consistency is just as eclectic (i.e., of multiple origin) as that which we can easily criticize. In other words, it is not eclecticism which is to be avoided but inconsistency in the result.

One is practically forced either to choose the exposition of one authority or to do one's own thinking. To choose a school of psychological thought is little more than a beginning because the agreement among those of a school is far from complete. A group is called a school because of some important area of agreement but beyond that, issues divide the school, as will be seen in the three chapters following. Because issues cut across schools as they do, and because of differences in emphasis or conviction, it is usually unsatisfactory to identify a writer with a school. It is partly or wholly due to this fact that Woodworth[5] finds many psychologists in the "middle of the road."

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[4] *Op. cit.*, p. v.

Reasons for Differences

Whether the student seeks a single authority as his guide, or chooses a single school of thought, or defines a working hypothesis of his own, he needs to be aware of some of the factors which are responsible for the differences. For even if he wishes to choose a single authority he will need a knowledge of the responsible factors as a basis for choice. What are some of these factors?

Different accounts of how learning takes place result in part from the fact that they have been derived from different kinds of data. One exposition may rest largely upon the learning of dogs to salivate at the experimenter's bidding, another upon the efforts of rats to find the food box in a maze, another upon the ease with which a cat can escape from a puzzle box, one upon the learning of very young children, another upon the learning of adults. Even with human subjects of similar maturity, the experimenter may have specialized upon memorizing, or upon the acquisition of motor skill, or upon the development of attitudes or appreciations, or upon the getting of understanding as in problem solving.

A very important factor accounting for differences in the description of the learning process is the purpose or design which prompts the theorist. The psychologist who is motivated to develop psychology as science will write *one* account of learning, the psychologist whose purpose is to guide educational practice will write another. This assertion is based upon the premise that an explanation is not good in and of itself, but that it is good for a purpose.[6]

[5] Woodworth, R. S., *Contemporary Schools of Psychology*, rev. ed., New York, Ronald, 1948, p. 254.

[6] The position taken here with reference to explanation is like the one which will be taken in Part III in the discussion of validity. There it will be maintained that it is better to ask how valid a certain *use* of a test is than to ask how valid the *test* is, as if validity were inherent in the test. In this account,

Educational Usefulness Must Be the Criterion

The psychology of learning is usually written by those who are trying to improve the status of psychology as science. It is written for students who themselves have the same objective. Does this effort result in the account which is most educationally useful? The answer of the scientist might be, "Yes, in the long run." And to this, we might agree. But education cannot wait. A working psychology of learning is of central importance to the worker in the field of education, whether he is supervisor, teacher, or guide. His psychology of learning must bear upon *every* educational problem, upon *every* phase of his work.

The scientist can wait. He can exercise patience and restraint in generalization. The educator cannot be so restricted. The scientist can limit generalization to those cases in which there is a high degree of validity. The working hypotheses of the educator must be all-embracing from the start; sound, perhaps, in some respects, but very weakly supported in many respects.

In a sense, the educator is as justified in setting up his broad and all-embracing hypotheses as the scientist is in framing his more limited and better supported hypotheses. The justification in both cases is, "Do you need and are you in a position to use and test the hypotheses you have framed?" If they are not to be used for prediction and to be tested, they have no usefulness. Because of his rigorous standards for testing hypotheses, the scientist proceeds slowly. Because the educator *must* have hypotheses concerning *all* phases of his work, he is forced to make

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the words "description" and "explanation" are used interchangeably. The author finds no sharp distinction between description and explanation. The vast difference between the most superficial and the most penetrating one is recognized, of course, but the difference is thought of as between extremes on a continuum. Some writers think of this as a qualitative difference, the difference between answering "How?" and "Why?"

See Miller, D. L., "The Meaning of Explanation," *Psychological Review*, 1946, 53:241–246.

But "Why?" is answered by supplying *more* "How?" information.

See also Guthrie, E. R., "On the Nature of Psychological Explanation," *Psychological Review*, 1933, 40:124–137.

far less rigorous tests of validity than are made by the scientist. If the educator were to restrict *his* "theory" to those respects which would permit precise or quantitative deduction, he would be at a loss to bridge the gap between theory and practice. Admirable and outstanding as efforts like Hull's[7] are as science, they are as yet far short of being adequate as a contribution to educational efficiency. To hold this opinion is not to belittle such efforts. There is only one way in which their possibilities may be determined, and that is through their serious and enthusiastic continuance.[8] But, at present, the results are so far from meeting educational needs as to make it very uncertain what the prospects are. It might be that the success of efforts along present lines would be largely limited to the areas of learning typically studied in the laboratory with lower animals as subjects. In other words, when it is as necessary for the scientists to describe all human learning as it is for the educator to direct it, the scientist may have materially revised his basic postulates.

There is another aspect of science which does not necessarily contribute to the maximum educational usefulness of exposition. It is the taboo upon the use of mentalistic language. It is gradually becoming more generally realized that "behaviorism" in its careful definition was not, even in the early stages,[9] and is not now a denial of conscious life. But within the ranks of science builders, to depart from the practice of strict operational definition is still to invite sharp criticism. An interesting aspect of the situation is a certain inconsistency. If a psychologist writes "your attention is called to the fact . . ." no criticism need be expected and the writer feels no sense of having erred. But if in the next paragraph he writes "attention is related in an important way to learning," he knows he may expect criticism. Words like "attention" have had meanings which he feels he must deny. Effort is sometimes made to strip such words of their discarded meanings by avoiding their substantive forms and referring only to their behavioral aspects, as, for instance, by using the word "attending" but not the word "attention." It is very doubtful, however, whether in a description of the learning process for educational application strict objectivity and the avoidance of mentalistic language is desirable. Teachers are in the habit of using mentalistic language. It is gradually being given operational meaning; and this trend should continue. But to force an exposition, which must be as embracing as education, into strictly objective terminology, would both restrict it and paradoxically render it less meaningful.

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[7] Hull, C. L., *Principles of Behavior*, New York, Appleton-Century, 1943.
Hull, C. L., "Behavior Postulates and Corollaries—1949," *Psychological Review*, May, 1950, 57:173–180.

[8] Hull, C. L., "A Comment on Dr. Adams' Note on Method," *Psychological Review*, 1937, 44:219–221.

[9] Smith, S., and Guthrie, E. R., *General Psychology in Terms of Behavior*, New York, Appleton-Century, 1921.

There is growing realization that a strictly objective account is incomplete. Even by B. F. Skinner [10] there is a recognition of the frequency with which responses cannot in the traditional laboratory way be related to stimuli. Constructs,[11] definable only indirectly in terms of objectively observable events, are being very cautiously introduced into psychological theory. The caution is understandable when it is realized that learning theory is largely based upon comparative psychology, and that modern comparative psychology set its house in order with a thoroughgoing taboo upon anthropomorphism.

But it is difficult to believe that when we want an understanding of human learning we must carefully avoid anthropocentrism. In 1933, Yerkes, with an established reputation in psychology, said, nevertheless, "I am today even more thoroughly convinced than at any previous time that to neglect or to abandon the systematic introspective and otherwise profitable investigation of mind is almost certain to be seriously detrimental to the development of man's knowledge and understanding of himself, to the profitable evolution of scientific disciplines, and consequently to the progress of civilization."[12] More recently Prentice[13] raised the question whether or not "positivism" isn't turning into a negativism by stifling the development of new and useful theories.

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[10] Skinner, B. F., *The Behavior of Organisms,* New York, Appleton-Century, 1938, pp. 19–21.

[11] Hilgard, E. R., *Theories of Learning,* New York, Appleton-Century-Crofts, 1948, pp. 263–265.

Spence, K. W., "Cognitive vs. Stimulus-Response Theories of Learning," *Psychological Review,* May, 1950, 57:159–172, p. 159.

It is a question of validity versus objectivity, and it is of importance both in the development of a learning theory and in evaluation. The position taken in this text with regard to both learning theory and evaluation is that coverage should be full and complete, if necessary at the sacrifice of some degree of objectivity.

In the early days of the educational measurement movement, the specialists were loathe to try to appraise in areas in which they could not use highly objective methods. Lawrence K. Frank illustrated the inadvisability of this attitude toward measurement in education with a story.[14] According to the story an officer found a considerably intoxicated man searching for his watch under a street lamp. After kindly helping for a while the officer had some doubts about the situation so he asked the man if he was sure he had lost a watch. Assured in the affirmative, the officer asked where, and was told by the searcher that the watch had been lost in the nearby alley. Asked why, with the watch lost in the dark alley, he was searching under the street lamp, he replied that the light was much better there.

This story is pertinent to all those situations in which we allow adherence to a standard of objectivity to come before the criterion of need. The science builder is apt to go only so far as he can go objectively, the educator must go all the way as objectively as possible. The educator must place first as a criterion the validity which can only be had from full coverage of all the aspects of human development which are educationally directable. Objectivity must be subordinated to need.

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[12] Yerkes, R. M., "Concerning the Anthropocentrism of Psychology," *Psychological Review,* 1933, 40:209–212, p. 211.

[13] Prentice, W. C. H., "Operationism and Psychological Theory: A Note," *Psychological Review,* 1946, 53:247–249.

[14] Barker, R. G., Kounin, J. S., and Wright, H. F., *Child Behavior and Development,* New York, McGraw-Hill, 1943, p. 2.

Some of the psychologists [15] who face this problem of application think that rather fundamental changes are needed in the definition of the psychologist's problem. The applied psychologist, facing the necessity of understanding persons as individuals, finds that much more is needed than a sum of the safe generalizations which can be made about people in general.

The "more" that is needed is not merely that which is due to the unavoidable gap between science and practice which has to be filled by the art of application. For one thing, the "truths" of psychology which are related to educational practice are too isolated and unrelated. Snygg and Combs [16] expressed the situation as follows: ". . . psychologists have been spending their time looking for facts while the teachers have been badly in need of theories. It seems self-evident that it is the task of psychology to provide more accurate information to educators but merely providing information is not enough. Without a background of theory to give it meaning and point up its implications no item of information is going to seem very important or have much influence upon educational philosophy and practice." The education student must therefore find or make such a theoretical integration concerning learning.

He will hold all positions tentatively, of course. Even the "facts" should be accepted tentatively, for they are interpretations. Psychological experimentation is very difficult, and as a consequence the interpretation of results is greatly subject to error. Although experiments are sometimes called "crucial," few if any deserve the title.

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[15] Allport, G. W., "The Psychologist's Frame of Reference," *Psychological Bulletin,* 1940, 37:1–28, especially pp. 12–23.
Lynch, J. M., "The Applicability of Psychological Research to Education," *Journal of Educational Psychology,* 1945, 36:289–296.
Snygg D., and Combs, A. W., *Individual Behavior,* New York, Harper, 1949, pp. 6–8, 335–347.

[16] *Op. cit.,* p. 205.

The Student's Frame of Reference

In the above paragraphs the student has been warned of respects in which psychology is not well designed to meet educational need. But the shortcomings are not all located in what psychology has to offer. The teacher may have a poor idea of the educational need. Schooling is organized in such a way that many teachers feel responsible for and interest in only a segment of the development of many pupils (often 175 or more). Schooling fractionates the learner as seriously as does the psychological-science builder. A teacher who from experience has such a limited interest in the learner will do well, in studying the psychology of learning, to step out of character for a while. He had better think of the more personal and more individualized relations which good parents have with their children, which some advisers for extracurricular activities have with the members of their groups, which a good football coach has with the members of the squad, which the remedial teachers have with the pupils receiving an especially individualized instruction, which counselors have with campers in a good camp, or such as obtain between headmaster and pupil in a good boarding school. If the study of the psychology of learning is approached with a broad interest in every phase of development, good, bad, and indifferent, the teacher's specialized responsibility will be seen in better perspective.

In the second place, the student should seek a conception of the learning process which is as well knit or tightly organized as the facts will permit. Other things being equal, the simpler the concept, the more it will be used. At the risk of oversimplification, the student should seek the simplest unified basic concept which promises validity in use.

The concluding suggestion in this introduction to the study of learning theory is offered to emphasize the importance of making such a study. Most education students, even those without experience, are aware that lives are shaped by the culture in which they are lived. But all should read some of the modern work in cultural anthropology[17] for a fuller and more detailed appreciation of the importance of that process.

Summary

Differences in data, in purpose and in the language used have been mentioned as in part responsible for the variety found in explanations of learning. The position taken was (1) that the education student must face the problem, difficult as it is, because of the vital importance in his work of a psychology of learning; (2) that his test of a psychology of learning is educational usefulness, i.e., helpfulness in all phases of educational effort; (3) that in securing the psychology of learning adequate for his needs he will consider more than the data from the laboratory. He will prefer highly objective and reliable data but he will not be limited by it. He will find validity in the full coverage of the educational effort.

Assuming the above orientation with regard to the general problem, what are the next steps? It is proposed that while the student continues his reading on the subject of learning he now consider the problem further in more detail. There are three important questions which learning theorists disagree in answering. Having taken a position in regard to these three issues, the student will be well on his way toward choosing a favored authority, or a favored school of thought, or toward a clarification of his own thinking.[18]

The three questions are:

1. To what extent should an explanation of learning be sought and reported in terms of the relationships between the elements of behavior?

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[17] Ehrich, R. W., "Anthropology: A Brief Survey," *The Scientific Monthly*, 1949, 58:343–353, especially 343–345.
Landis, P. H., *Man in Environment*, New York, Crowell, 1949, Chap. 29.
MacIver, R. M., and Page, C. H., *Society*, New York, Rinehart, 1949, pp. 49–62.

[18] Possibly to some readers it may seem unwise to encourage the student to do his own thinking with regard to the psychology of learning. The wisdom in it lies in the belief that the educator interested in testing his own psychology of learning is the educator who is improving the efficiency of the educational process. This book is directed to those with such interest and ability.

2. To what extent should the explanation be in terms of the prior experience of the learner?
3. If in answer to question two, learning is explained wholly or in part in terms of prior behavior, what part do the effects of the behavior play?

These three questions [19] are of such importance that they will receive separate consideration in the three following chapters.

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[19] Readers familiar with the theory of learning may wonder why a fourth issue, "continuity" is not included. (K. S. Lashley, "An Examination of the 'Continuity Theory' as Applied to Discriminative Learning," *The Journal of General Psychology*, 1942, 26:241–265.) The reason is that the continuity issue in its most fundamental aspect is the question which is considered in the following chapter. It will be seen in chapter eight that the continuity issue has not been ignored.

CHAPTER II

EXPLANATION IN TERMS OF ELEMENTS?

The Tradition
Atomism and Behaviorism Are Not Synonymous
Atomism Is Not Synonymous with S-R Psychology
The Issue Antedates Gestalt Psychology
Wholistic Influences Other Than Psychological
Psychologists' Reaction to Wholistic Influences
Is the Wholistic Criticism Met?
What Are the Objections to a Wholistic Premise?
Summary and Conclusions

The Tradition

In 1898, Titchener wrote[1] that ". . . just as histological observation shows that the animal is not made up of a single uniform substance . . . , so does psychological observation show that no concrete mental process, no idea or feeling that we actually experience . . . , is a simple process, but that all alike are made up of really simple processes blended together. These simple processes are called *mental elements.* They are very numerous: there are probably some 50,000 of them . . ." The psychologist's task, Titchener continued to point out, is (1) to "give an exact account of the elementary processes," (2) to state the laws governing their "connection" in consciousness, and (3) to describe the bodily conditions for (1) and (2).

Such a formulation of the psychologist's problem is likely to result in an emphasis upon the first step; for the scientist, as pointed out in chapter one, wants to go no further nor faster than he can go carefully. For example, eleven years after Titchener wrote the above statement, he wrote: [2] "It is very important that we make no mistake as regards the nature and number of the elementary mental processes. For those elements are the simple materials out of which we are to build up our entire psychology. They must therefore be various enough and numerous enough to give rise, by their connections, to all the complicated phases of the human mind: . . . On the other hand, they must be strictly elementary; they must remain unchanged, however persistent our attempt at analysis . . ."

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[1] From Titchener, E. B., *A Primer of Psychology,* New York, Macmillan, 1898, pp. 21–22. By permission of John B. Titchener.

Wundt in his *Outlines of Physiological Psychology* approached the task with more concern for the related physiology but no less analytically. Analysis was the emphasis of the period.

To this emphasis upon analysis into elements, Wertheimer objected in a paper, "Perception of Apparent Movement." [3] His "phi-phenomenon" [4] was not a discovery. His concern was to take issue with the sort of explanation which a psychologist who is always seeking to analyze, is apt to make. Wundt had attributed what Wertheimer called the phi-phenomenon to a blend of sensations including those from the movement of the eyeball. But Wertheimer found (1) that the total time involved was less than the minimum eyeball reaction time, (2) that the phenomenon occurs with rigid fixation, and (3) that it can be simultaneously produced in opposite directions.[5]

This paper, which appeared in 1912, is often considered the beginning of the emphasis in psychology known as Gestalt psychology, especially as it affected the American scene.[6] And the

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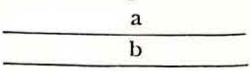
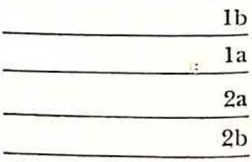
[2] From Titchener, E. B., *A Textbook of Psychology*, New York, Macmillan, 1909, p. 46. By permission of John B. Titchener.

[3] See Hartmann, G. W., *Gestalt Psychology*, New York, Ronald, 1935, p. 3.

[4] That a line shown at b shortly after a line is shown at a will be seen as a line moving from a to b.



[5] That is, while line 1a is seen as moving from 1a to 1b, line 2a may be seen as moving from 2a to 2b.



[6] Boring, E. G., *A History of Experimental Psychology*, New York, Century, 1929, pp. 571, 592.

essence of this movement was its protest against the element-centered explanation described above. Wertheimer, and with him Köhler and Koffka, considered psychological experience unanalyzable and that to "describe" it in terms of artifacts (i.e., "elements") is to serve no valid purpose. In the course of this protest, the term "atomism" [7] was frequently used to refer to the objectionable search for explanation in terms of elements. Using this term, the issues of this chapter may be described as a modern phase of the issue between atomism and wholism.

Atomism and Behaviorism Are Not Synonymous

The issue of the chapter would not be as precisely labeled if it were called the issue between behaviorism and Gestalt psychology. Behaviorism tended to be almost as atomistic as the more mentalistic psychology of an earlier period. From the point of view of a wholistic critic, it simply substituted a preoccupation with one kind of artificial element, the reflex arc, for preoccupation with another, the sensation or idea. The objection to labeling the issue as a challenge to behaviorism is that behaviorism was, and should be referred to, as essentially a turning from a chief reliance upon introspection to a chief reliance upon objective observation. To know that a psychologist was or is a behaviorist is to know no more about him than that reliance upon objective data. There was in the first behavioristic text [8] no denial of consciousness. Smith and Guthrie [9] introduced their account by saying that "a behavioristic description of a man's mind in no way contradicts the common-sense assumption that men are conscious." Dashiell [10] wrote as a part of his introduction that an objective psychology "challenges no political, ethical, religious, social, romantic, or other humanistic conception of his (man's) life and destiny." There is in fact no justification in science for the denial of the existence of a factor which may not be studied by scientific, i.e., objective, methods. In so far as behaviorism is to be criticized from a wholistic position, it is on the grounds of such inadequacy as was pointed out in chapter one. Objective observation needs to be supplemented rather than discredited.

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[7] After the teaching of the Greek philosopher Leukippos or of his follower, Demokritos (about 400 B.C.).
Pillsbury, W. B., *The History of Psychology*, New York, Norton, 1929, pp. 15–18.

[8] Meyer, Max, *The Fundamental Laws of Human Behavior*, Boston, Gorham Press, 1911.

[9] From Smith, S., and Guthrie, E. R., *General Psychology in Terms of Behavior*, New York, Appleton, 1921, p. 1, by permission of the publishers.

[10] From Dashiell, J. F., *Fundamentals of Objective Psychology*, Boston, Houghton Mifflin Company, 1928, p. 18, by permission of the publishers.

Atomism Is Not Synonymous with S-R Psychology

Nor, in the second place, would the issue of this chapter be defined by calling it the issue between Gestalt and "S-R bond psychology," "stimulus-response theory," or "connectionism." Again, as in the discussion of behaviorism above, it is admitted that S-R theory has tended to be atomistic. But is atomism inherent in psychological description which notes relations or connections between the stimulating situation and the response of the organism? What is the essential nature of an S-R theory? Isn't the wholistic position critical of what S-R theory happens to be rather than of what it essentially is?

S-R theory is not in essence a neurological theory. Take Thorndike's exposition [11] for example. In it, to be sure, there was generous use of a somewhat atomistic picture of the hypothetical neurological foundations of psychology. But what Thorndike had to say about psychology was based more upon *psychological data* than upon *neurological theory*. An S-R bond or connection was to Thorndike first and foremost an observed relation between the stimulating situation and the behavior of the organism. Change in neurological theory did not cause him to cease noting such relationships, nor make such observation any less useful. In the last analysis such observations have validity and usefulness to the extent that they have been based upon valid, objective and comprehensive *psychological* observation.

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[11] Thorndike, E. L., *Educational Psychology*, Vols. 1 to 3, New York, Teachers College, Columbia University, 1913.

This has not been always understood, so that when Lashley's experiments [12] with controlled cerebral destruction in the rat led him to postulate a quite different sort of brain activity than Thorndike pictured, it was concluded by some that Thorndike's psychology had been pretty well discredited because it was an S-R bond psychology.[13] But since S-R bonds or connections are objectively observed relationships, what is challenged is not the bond or connection but only its supposed neurological nature. If you find an S-R bond psychology acceptable on psychological grounds you are free to imagine "the determination of reactions by patterns or ratios of excitations." [14]

No brief is being made for Thorndike's or any particular psychology. The point is that atomism is not inevitable in S-R theory. There is no fundamental inconsistency between S-R concepts and a wholistic emphasis. It is because of this fact that an account like that of A. I. Gates [15] can be so much less atomistic than that of Sandiford [16] though both accounts are fully based upon the reaction hypothesis. Also, it is because of this fact that the differences between an extreme atomism and an extreme wholism can be gradually reduced.[17] Note that there is a wholistic emphasis and at the same time an S-R emphasis in the following quotation from Child.[18] "The Organism represents an order and unity in protoplasm which is related at every point to the external world. The development and evolution of organismic integration are essentially the evolution of mechanisms and methods of response and adjustment to environmental conditions."

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[12] Lashley, K. S., *Brain Mechanisms and Intelligence,* Chicago, University of Chicago Press, 1929.

[13] Gray, J. S., *Psychological Foundations of Education,* New York, American Book, 1935, p. 60.

[14] From Lashley, *op. cit.,* Chap. 11, p. 166, by permission of the publishers.

[15] National Society for the Study of Education, *41st Yearbook,* Part 2, *The Psychology of Learning,* Bloomington, Ill., Public School Publishing, 1942, Chap. 4.

[16] *Ibid.,* Chap. 3.

[17] Gates, A. I., *loc. cit.,* pp. 142–143 and 163–164. See also, Simpson, R. G., *Fundamentals of Educational Psychology,* Philadelphia, Lippincott, 1949, p. 194.

[18] From Child, C. M., *The Origin and Development of the Nervous System from a Psychological Viewpoint,* Chicago, University of Chicago Press, 1921, p. 7, by permission of the publishers.

As Carmichael [19] stated it, "The fact that an early concept of the reflex arc was inadequate is no reason to assert that there is no truth in the general view that behavior involves discoverable relationships both temporal and anatomical between stimulation and response."

Practically all psychology is S-R bond psychology of a sort. Indeed, it is difficult to conceive of adequate psychological explanation or description which would not link behavior (responses) with situation (stimuli). Objective description demands it. Kantor [20] wrote that ". . . it is probably inevitable that psychologists should work with stimulus response conceptions." He was of the opinion "that those experimental studies which throw into relief the stimulus-response problems, even when the workers themselves think they are detrimental to stimulus-response psychology, are on the contrary aids to a more effective determination of stimulus-response phenomena, and incidentally support stimulus-response psychology." It may be said, then, that in general, psychological exposition links S with R; and that neither a change in neurological concepts nor a greater wholistic emphasis is likely to make such linkage unnecessary in psychology. That being the case, to classify theories for purposes of contrast, some as S-R theories and some not, is to divert attention from the issues.

The Issue Antedates Gestalt Psychology

We continue by negation to define the issue of the present chapter. Having pointed out that a behavioristic psychology may or may not be atomistic, and that S-R connections may or may not be atomistically described, a third observation needs to be made. It is that the wholistic objection to atomism in psychology is not with sufficient accuracy described as the issue of Gestalt versus atomistic psychology.

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[19] Reprinted by permission from p. 150 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

[20] From p. 335 of Kantor, J. R., "In Defense of Stimulus-Response Psychology," *Psychological Review*, 1933, 40:324–336, by permission of the American Psychological Association.

Criticisms of atomism in psychology had been made before the Gestalt psychologists made them. J. S. Mill [21] wrote that "the Complex Idea, formed by the blending together of several simpler ones, should, when it really appears simple . . . be said to *result from,* or be *generated by* the simple ideas, not to *consist of* them . . . These are cases of mental chemistry: in which it is possible to say that the simple ideas generate, rather than that they compose, the complex ones." This was his criticism, that is, his way of improving over the extreme atomism in the elder Mill's account. James Mill had classified all consciousness as either (1) elementary sensations, (2) ideas (copies, images, or traces of sensations), (3) aggregates of sensations or of ideas or of both, or (4) trains of sensations or of ideas or of both. "From a stone I have had synchronically, the sensation of colour, the sensation of hardness, the sensation of shape, and size, the sensation of weight. When the idea of one of these sensations occurs, the ideas of all of them occur. They exist in my mind synchronically; and their synchronical existence is called the idea of a stone; which, it is thus plain, is not a single idea, but a number of ideas in a particular state of combination." [22]

In later psychological accounts, such as Titchener's, it was always disclaimed that the complex was an aggregate. But that is about as far as the shift from atomism went. It was practically impossible to be so concerned with a description of the elements without thinking of them as having an independent existence. Witmer, for instance, introduced his text with the statement that sensations as simple elements actually do not exist.[23] But within two pages there is an implication that they do exist.[24]

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[21] Mill, J. S., *A System of Logic, Ratiocinative and Inductive,* London, Parker, 1843, Book 6, Chap. 4, Sec. 3.

[22] Mill, James, *Analysis of the Phenomena of the Human Mind,* London, Baldwin and Cradock, 1829, Vol. 1, p. 57.

[23] Witmer, L., *Analytical Psychology,* Boston, Ginn, 1902, p. 7.

[24] *Ibid.,* p. 9.

No account of the criticism of atomism in psychology prior to Wertheimer's 1912 article would be complete without mention of the functionalists. Angell's 1906 presidential address before the American Psychological Association [25] was a criticism of element-centered explanation. Ten years earlier Dewey [26] had criticized atomism in the use of the reflex arc concept. Still earlier James had written his much-read *Principles of Psychology*. He introduced his "Stream of Thought" chapter as follows: [27]

> We now begin our study of the mind from within. Most books start with sensations, as the simplest mental facts, and proceed synthetically constructing each higher stage from those below it. But this is abandoning the empirical method of investigation . . . It is astonishing what havoc is wrought in psychology by admitting at the outset apparently innocent suppositions, that nevertheless contain a flaw. The bad consequences develop themselves later on and are irremediable, being woven through the whole texture of the work. The notion that sensations, being the simplest things, are the first things to take up in psychology is one of these suppositions. The only thing which psychology has a right to postulate at the outset is the fact of thinking [by which James referred to all forms of consciousness] itself, and that must be taken up and analyzed. If sensations then prove to be amongst the elements of thinking, we shall be no worse off as respects them than if we had taken them for granted at the start.

James then proceeded to describe the stream of thought under five headings, the third being an emphasis upon its continuity, and no one of the five was an analysis of thought into its constituent elements. By the time the reader reaches the discussion of the traditional topics, sensation, imagination, and perception, etc. in the second volume, he has had from the first volume a picture of an integrated continuous process which is a good antidote to atomism.

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[25] Angell, J. R., "Psychology of Mental Operations in Contrast to the Psychology of Mental Elements," *Psychological Review*, 1907, 14:61–91.

[26] Dewey, J., "The Reflex Arc Concept in Psychology," *Psychological Review*, 1896, 3:357–370.

[27] From James, William, *Principles of Psychology*, New York, Henry Holt and Company, 1890, Vol. 1, p. 224, by permission of the publishers.

Mention has been made of J. S. Mill, James, Dewey, Angell, Wertheimer, Köhler, and Koffka as critics of atomism, but there has been no effort to describe the history of such criticism with any fullness. To do so fully either within or without the ranks of those who have called themselves Gestalt psychologists would be a difficult task.[28] The intention here was to give an appreciation of the age and deep-seated importance of the issue raised in this chapter which is not brought out by speaking of it as if it were merely the current issue between the Gestalt and the more atomistic psychologists.

Wholistic Influences Other Than Psychological

Furthermore, the issue is not limited to psychology. There are other influences counteracting atomism in psychology than those growing out of psychological observation. There are two which have not operated to determine psychological theory directly so much as they have operated to discredit atomistic explanation. One is religious belief. Most believers see in any highly atomistic attempt to explain human life a denial of that which they think is responsible for its integrity.

Another influence which has tended to discredit atomistic descriptions of the learning process is education. Educators tend to associate atomism in psychology with, if not to blame it for, a period of educational theory and practice upon which they have turned their backs.[29] It was a period when too little concern was had for the learner as an individual, too little thought was given to what was being done to the learner while he was learning or not learning to recite, and when too much satisfaction was had from a learner's being able to recite unrelated and rather meaningless things; in short, when education was too often thought of as the bit-by-bit addition of the required store of knowledge. Educators today are alert to take advantage of the values which come from seeing things whole and in as large a frame of reference as possible. They are particularly mindful of their experiences in the teaching of reading.

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[28] Heidbreder, Edna, *Seven Psychologies*, New York, Century, 1933.
Woodworth, R. S., *Contemporary Schools of Psychology*, rev. ed., New York, Ronald, 1948.

[29] Brubacher, J. S., *Modern Philosophies of Education*, New York, McGraw-Hill, 1939, pp. 116–117, 255–256.

Operating more directly is the influence of modern physics. In the beginnings of science, all explanation took its cue from mechanics. The machine was explained by taking it apart, describing the parts, and describing how the parts were assembled. That is no longer the pattern in this age of radioactivity. The atom is no longer *the* element. Physicists are concerned about subatomic energy. The process which the physicists have observed and controlled is not a process from the simple to the complex. The heavy uranium disintegrates into simpler atoms. In other words, the physicist has traced the simple to, or "explained it" in terms of, the more complex. In fact, the physicist today does not postulate any part or element which has all its properties intrinsically. An "element" is what it is in part by virtue of its relation to a field and to an observer. The influence of physics upon psychological explanation is apparent in the use of the term "field theory" by psychologists.

A similar influence has been exerted by biological thought. Biology from the outset was an interest in a functioning whole organism as opposed to an interest in anatomy or in classification. Darwin's influence accentuated this interest. The trend has been to describe parts with due regard to their place in the organism and to show how the parts acquire their attributes by reason of their membership character. And this has been true throughout the sequence of genetic, embryological, and infant development.

Reference has been made earlier in this chapter to the wholistic theory of brain action advanced by Lashley. He concluded from his data ". . . that the structural elements are relatively unimportant for integration and that the common elements must be some sort of dynamic patterns determined by the relations or ratios among the parts of the system and not by the specific neurons activated."[30]

As a matter of fact, neurological accounts prior to Lashley's work were not so extremely atomistic (remember that atomism in the use of the reflex arc concept had been criticized in 1896) as some suppose. In 1906 Sherrington wrote of the first section of his treatment:[31] "We have hitherto dealt with reflex reactions under the guise of a convenient but artificial abstraction—the simple reflex. That is to say, we have fixed our attention on the reaction of a reflex-arc as if it were that an isolable and isolated mechanism, for whose function the presence of other parts of the nervous system and of other arcs might be negligible and wholly indifferent. This is improbable. The nervous system functions as a whole. Physiological and histological analysis finds it connected throughout its whole extent." According to Carmichael,[32] "the 'cell theory' and 'reflex theory' that are usually attacked by organismic writers are in most such criticisms 'men of straw.' "

But we may not infer from this statement that Carmichael's thinking is wholistic without reservation. As his broad generalization, he offers his belief "that an excellent case can be made out for the view that *individuation* (priority of the whole) is the pattern of all development, including all learning, but certainly in the experimental situation the concept of the *integration* or the combination of responses also provides, at times, a convenient working hypothesis."[33]

Nor is this generalization contrary to Lashley's position. Lashley, in his presidential address before the American Psychological Association the same year his book was published, said, concerning morphogenesis and concerning the organization of the nervous system, "in both there is evidence that every part may influence every other; in both there is a possibility of dissociation and independent activity of some parts." [34] That the wholistic biological aspects of behavior are influential upon psychological thinking is attested by the frequent use of the word "organismic" in psychology.

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[30] From p. 173 of *Brain Mechanisms and Intelligence*, by K. S. Lashley, University of Chicago Press, 1929, by permission of the publishers.

[31] From Sherrington, C. S., *The Integrative Action of the Nervous System*, New York, Scribner, 1906, by permission of the publishers.

[32] Reprinted by permission from p. 149 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

[33] Reprinted by permission from p. 151 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

Psychologists' Reaction to Wholistic Influences

But what do psychologists say about atomism in current psychology from psychological considerations? Psychological explanation is so much less atomistic than was the James Mill account that the most frequent reaction to criticism is "straw-man"! Boring wrote: [35] "I doubt if any psychologist has seriously held to the 'bundle hypothesis' since James Mill in 1829." [36] To Thorndike the atomism of that period seemed ". . . as unnecessary and fantastic . . . as it does to Wertheimer, Köhler, Koffka, or Ogden." [37] Guthrie wrote [38] that "A great deal of writing has been directed against views held by a mythical misguided person but not held by any actual psychologist." Earlier in the same work (p. 19) he noted that "The Gestalt psychologists have recently placed a great deal of emphasis on the assertion that behavior is always a response to a total situation. So far as I know, this has never been disputed, and it is of great importance to bear it in mind." And later in the same work (p. 222), Guthrie ex-

[34] From Lashley, K. S., "Basic Neurological Mechanisms in Behavior," *Psychological Review*, 1930, 37:1–24, p. 20, by permission of the American Psychological Association.

[35] From *Psychologies of 1930*, Worcester, Mass., Clark University Press, 1930, Chap. 6, "Psychology for Eclectics," by permission of the publishers.

[36] The use of the word "bundle" is due to the fact that Hume said that man is ". . . nothing but a bundle or collection of different perceptions which succeed each other with an inconceivable rapidity . . ." Hume, D., *A Treatise of Human Nature*, Vol. 1, Book 1, Part 4, Sec. 6.

[37] From Thorndike, E. L., *Human Learning*, New York, Century, 1931, p. 124, by permission of the publishers.

[38] From Guthrie, E. R., *The Psychology of Learning*, New York, Harper, 1935, p. 188, by permission of the publishers.

pressed himself as ". . . in entire agreement with the Gestalt 'laws' of perception . . ." except for a limitation which will not be discussed here because it is the concern of chapter three. Hull, in a reference [39] to his own principle of afferent interaction and to Köhler's hypothesis of dependent part qualities, notes "That two approaches popularly supposed to be as diverse as that of Köhler and the present one find important use for what at bottom seems to be the same principle, encourages the view that current theoretical approaches differ far less than might be suggested by their diversity of terminology and the occasional acrimony of theoretical controversies."

Is the Wholistic Criticism Met?

Clearly, the many years of wholistic influence have had a great effect upon psychological thinking. Is the gap between atomism and wholism practically closed? The answer must be "yes and no." Looking back, one is inclined to say "yes" for reasons indicated above.

But perhaps the opinions minimizing the gap are overly optimistic. Perhaps the important thing is not that Thorndike used a wholistic concept like belongingness,[40] described connections from whole situations, and from the pattern of gross situations,[41] but that he never modified his basic approach to the task.[42]

In the following quotation the gap between psychologists is described as if it had in nowise been decreased. "The psychologies of Titchener, Thorndike, and Woodworth, insisting upon the foundation of connections, . . . can never be made over into configurational psychologies. . . . Attempts at eclecticism are of no avail because the original assumptions of these psychologies preclude an eclecticism. . . . The mechanistic and organismic systems are both all-or-none systems. They begin on opposite sides of the part-whole dichotomy. The assumptions necessary for one are precluded by the other. There is no carrying of water on both shoulders. An eclectic or middle position is impossible. One or the other is totally wrong. It is a choice between them." [43]

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[39] National Society for the Study of Education, *41st Yearbook,* Part 2, *The Psychology of Learning,* Bloomington, Ill., Public School Publishing Co., Chap. 2, pp. 77, quoted by permission of the Society.

[40] Thorndike, E. L., *Human Learning,* New York, Century, 1931, pp. 16–29.

[41] *The Fundamentals of Learning,* New York, Bureau of Publications, Teachers College, Columbia University, 1932, pp. 353, 354.

[42] Thorndike, E. L., *Selected Writings from a Connectionist's Psychology,* New York, Appleton-Century-Crofts, 1949.

Exception may be taken to certain phases of this statement, but after discounting the "either, or" language, one still has an important difference to consider. The James statement considered earlier in the chapter may be helpful in this connection. When quoted, it was considered with reference to the *history* of the issue of this chapter. It needs to be considered *now* as to its implication for the *present*. He wrote: "It is astonishing what havoc is wrought in psychology by admitting at the outset apparently innocent suppositions that nevertheless contain a flaw. The bad consequences develop themselves later on and are irremediable, being woven through the whole texture of the work." Perhaps to meet present-day criticism of atomism it is necessary to start from wholistic basic postulates. That is, it may be impossible to make as much progress by patching up an inadequate explanation based on poor premises as could be made from a better set of basic postulates.

What Are the Objections to a Wholistic Premise?

Thorndike expressed suspicion [44] of the concepts which are involved in a wholistic approach because they have lent themselves to vitalistic interpretation. The fact that they do so lend themselves is either a merit or a fault according to one's belief. The fault which Thorndike attributed to a belief in vitalism is that it stifles inquiry. But to recognize this fault is slight basis for a decision to start or not to start with a recognition of the integrity of human behavior.

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[43] From Wheeler, R. H., Perkins, F. T., and Bartley, S. H., "Errors in the Critiques of Gestalt Psychology. IV. Inconsistencies in Woodworth, Spearman and McDougall," *Psychological Review*, 1933, 40:412–433, pp. 432–433, by permission of the American Psychological Association.

[44] Thorndike, E. L., *Human Learning*, New York, Century, 1931, p. 125.

More to the point is his opinion that "few of the units into which behavior may be divided are configurations in the strict sense of things, 'the unitariness of which defies analysis,' which are 'transposable like melodies,' and which 'when they appear or disappear do so altogether.' "[45] In other words, he thought that the contention that all responses are so patterned is extreme; that the wholist should not claim that *all* behavior requires description in wholistic terms.

Two objections stated by Guthrie are important. The first one he raised immediately as a serious qualification of the statement, quoted above, in which he admitted the importance of the total situation. "But any attempt to predict from the total situation is hopeless. 'A,' the antecedent term in our general formula for scientific laws, can not be a total situation because total situations are never repeated, and science can not deal with events that are unique."[46] The second objection was a qualification of his agreement with the Gestalt "laws" of perception. He disagreed only in that he "would search for the origins of specific differences in the perceptions of different individuals in their individual histories of conditioning." This objection raises another issue. It is related and important but it is the issue of the following chapter.

Summary and Conclusions

Much of this chapter is devoted to the definition of the atomism-wholism issue. It was presented as primarily a psychological issue though other data and considerations were recognized as related. The issue of behaviorism and the issue of S-R theory or connectionism were shown not to be fundamentally, i.e., of necessity, related to the issue of atomism versus wholism. Clear thinking seems impossible without such a reduction of the issue to its essential nature.

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[45] *Ibid.*, p. 129. His quotes were from Ogden, R. M., *Psychology and Education*, New York, Harcourt, Brace, 1926, p. 127.

[46] National Society for the Study of Education, *41st Yearbook*, Part 2, *The Psychology of Learning*, Bloomington, Ill., Public School Publishing Co., p. 19, quoted by permission of the Society.

Sketchily, there is illustrated in the chapter the history of a great reduction of atomism in psychological thinking since the time of James Mill. Today there is not the slightest tendency to favor a thoroughly atomistic description of the learning process. It is difficult to say what the alternatives are, or how many there are, but they may be described as three:

1. To proceed with explanation so far as possible *as if* the independence of parts were the case, and then to extend the theory in the direction of wholism but within the "as if" framework. Thorndike's *Human Learning* seems to be an illustration of this approach.
2. To explain the acquisition of habits and memoritor skills within an "as if" framework but to explain perception, meaning, and understanding in terms of wholistic concepts. An illustration is Goodenough's *Developmental Psychology*.[47]
3. To give up the "as if" approach and to proceed from wholistic premises. The Wheeler and Perkins book[48] illustrates such an effort.

The first approach will prove valid to the extent that Thorndike was right in thinking that "few" of the complex aspects of behavior have psychological unity. The second choice is a popular one. Probably it is considered to be the most practical one by those to whom it appeals. Also they are likely to think, at present at least, that any other course is an oversimplification.

The choice made in this book is the third. The position taken is that the data of educational development requiring wholistic description are numerous and important, and that the need cannot be met with an "as if" approach.

The second course may not be as practical as it seems. If there is no fundamental dichotomy; if there are common basic principles concerning all learning, then the second procedure is but a temporary step in the direction of a more thorough reworking of basic postulates. Since this is believed to be the case, it is thought that this second procedure, by emphasizing difference and dichotomy, delays the definition and use of the common basic concepts. ✓

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[47] Goodenough, Florence, *Developmental Psychology*, New York, Appleton-Century, 1945.

[48] Wheeler, R. H., and Perkins, F. T., *Principles of Mental Development*, New York, Crowell, 1932.

For the reader who has decided to start from wholistic postulates, the next question is the one posed for the following chapter.

CHAPTER III

EXPLANATION IN TERMS OF PRIOR EXPERIENCE?

The Traditional Explanation in Psychology
The Tradition Criticized as Atomistic
Lewin's Position
Emphasis upon Field Theory
Neurological Validity of Historical Explanation
Emphasis upon Maturation
Summary and Conclusions

The Traditional Explanation in Psychology

In the concluding section of the preceding chapter the choice made was "To give up the 'as if' approach and to proceed from wholistic premises." [1] Having made this choice, one is faced with another important issue, the question raised in the title of this chapter.

Explanation in terms of prior experience is the tradition in the psychology of learning. "Laws" of learning have related present behavior to prior behavior; they have "explained" present behavior in terms of prior experience. The laws have said, "You have learned because you practiced," "You have learned because you were interested," etc. "Your learning is related to or due to what you did in this respect and that respect."

As a part of traditional thinking, it is usually taken for granted, if not explicitly assumed, that the prior experiences bring about modification of behavior by modifying the structure of the brain in some way, i.e., by leaving traces of some kind. It is thought, in other words, that experience modifies the organism; and that the organism responds differently after the experience than it did before because it is a somewhat different organism.

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[1] The quoted statement is redundant because to give up the "as if" approach is to proceed from wholistic premises. The term "'as if' approach" was used in the preceding chapter to refer to attempts at explanation which begin *as if* there were independence of parts.

This sort of explanation, by reference to the past, has been so universal and so invariable that it constitutes the definition of learning for many, if not for most people. For many people learning is that which is attributable to what was done at school.

The student who is asking what kind of an account of learning is best for his purposes needs to ask the question posed for this chapter. Does the traditional effort to explain in terms of prior experience still have a place in a modern educational psychology? And, if it does, how much of a place does it have?

For the sake of brevity, the traditional efforts at explanation in terms of prior experience will be referred to as historical explanation. They will be called historical, not because they are traditional in the psychology of learning, but because the explanation is sought in the personal history of the learner.[2]

The Tradition Criticized as Atomistic

The *Principles of Mental Development* by Wheeler and Perkins was mentioned in the last section of the preceding chapter as an example of an effort to correct at the roots, so to speak, for the error of atomism. This book was offered as an example, in part because Koffka thought of Wheeler as "the foremost American champion of Gestalt theory," [3] and in part because it was written as a textbook in educational psychology.[4] But a third reason for referring to the book was the need to consider it with reference to the issue of the present chapter.

The Wheeler and Perkins approach is an extreme and abrupt departure from tradition, as the reader may have expected it to be from reading of the quotation from Wheeler, Perkins, and Bartley in the preceding chapter. In proceeding from a wholistic premise, they considered it necessary to avoid the whole traditional approach. Historical explanation, as they saw it, was atomistic in nature. It was not to be discarded by them merely because it had been long *associated* with atomism; for them, it *was* atomism.[5]

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[2] This use of the word "history" is not original. It will be found later in the chapter in a quotation from Lewin published in 1935. It may be seen in Jennings, H. C., *Behavior of the Lower Organisms*, New York, Columbia University Press, 1906, pp. 178, 253.

[3] From Koffka, K., *Principles of Gestalt Psychology*, New York, Harcourt, Brace, 1935, p. 457, by permission of the publishers.

[4] The subtitle of *The Principles of Mental Development* is *A Textbook of Educational Psychology*.

Lewin's Position

Lewin, on the other hand, whose thinking was just as thoroughly based upon a wholistic premise, realized that historical explanation need not be atomistic. He described a place for historical explanation as follows: [6]

> The question "why" can have two very different meanings in psychology . . .
>
> A physical example: I am sitting in the rain under a tree whose leaves keep me from getting wet. I ask: "Why don't I get wet?" It is possible to answer this question by finding out the direction and velocity of the falling drops, the position of the leaves, my own position, etc. In short, one can represent the present situation and, by applying the laws of mechanics or other relevant laws, derive what event must occur in such a situation. But the answer to this question could also be as follows: "It is thanks to your grandfather who planted this tree that you do not get wet. To be sure, the soil is not very good right here, but your grandfather took special care of the tree during its first years. Yet if the plan for a new state road had gone through last year, the tree would already have been cut down and you couldn't sit here without getting wet."
>
> The second answer is an example of explanation in terms of historical causality. Its characteristic feature is that it gives an account of the course and intervenings of causal chains of events, events which happened but once and which can be placed in certain years and certain geographical

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[5] Wheeler, R. H., and Perkins, F. T., *Principles of Mental Development*, New York, Crowell, 1932, pp. 10–12.

For Wheeler, the issue is by no means merely psychological. It is a whole pattern of thought and of logic and an issue of vital importance in education. Wheeler, R. H., "A Set of Postulates for Educational Theory, I. The Background," *Journal of Educational Research*, 1934–1935, 28:321–333; "Postulates for a Theory of Education, II. A Methodology for Educational Research," *Journal of Educational Research*, 1935–1936, 29:187–195.

[6] From *Principles of Topological Psychology* by K. Lewin. Copyright, 1936. Courtesy of McGraw-Hill Book Co.

locations. The answer in terms of systematic causality on the other hand refers to types and to laws in which there are no dates. Both answers are entirely legitimate and important, but neither is a substitute for the other, although one has bearing on the other. For psychology both types of answer are important. The historical concept plays an especially important role in developmental psychology, both of individuals and of groups.

Emphasis upon Field Theory

But Lewin's picture of the legitimate and important part to be played by historical explanation is not evident in the Gestalt literature, not even in his own writing. The emphasis is upon what, in the above quotation, Lewin called systematic explanation. Because of this emphasis and statements like those in the Wheeler and Perkins book, many students get the impression that Gestalt effort is an effort to *replace* an inferior historical type of explanation with a more valid nonhistorical explanation.

It is easy even for the psychologist to take such an attitude, for the systematic, nonhistorical, or field-theoretical effort in psychology is a closer identification of psychology with the older sciences. There is a prestige attached to psychological explanation which is so identified. For instance, what would one natural scientist think of another if the second, when asked to explain the behavior of a stone as it rolled down a hillside, replied that he would have to know more about the history of the stone, especially about its closely related experiences and the circumstances of those experiences? The critics of historical explanation in psychology point out that the only data needed for the use of a natural science law are such as are obtainable in the present, that is, when it is desired to apply the law. The thought is that psychologists must seek to discover such laws, for without them psychology is "explaining" at a very naive level.

Lewin's efforts in this nonhistorical direction have been particularly influential, especially in reference to group dynamics. A good example of the use of his concepts may be seen in Brown's *Psychology and the Social Order.*[7] Brown introduces the reader to the use of field concepts in the first eighty-one pages of the book, and this introduction is a good description of psychological field theory.

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[7] Brown, J. F., *Psychology and the Social Order,* New York, McGraw-Hill, 1936.

Although psychological effort has achieved no laws of dynamics in the strict meaning of the term "law," [8] psychological description in terms of field concepts has appealed to many readers. A natural science terminology is receiving psychological meaning. Description in terms of regions and barriers, equilibria and tensions, rigidity or fluidity of structure, etc., cannot in its early stages be as fundamental an explanation as the number of words borrowed from natural science would indicate. Nevertheless, it is reorganizing and hence stimulating psychological thought. And the more nonhistorical explanation is emphasized, the less attention historical explanation claims.

Neurological Validity of Historical Explanation

But a de-emphasis upon historical explanation is not enough for critics like Wheeler and Perkins. As they see it, the traditional effort to explain in terms of experience is not only atomistic, as stated in an earlier section, but is a misguided effort at biological explanation, since it rests upon the postulation of neurological traces, which postulation they think is untenable.

> . . . A given experience is not represented by a brain pattern except when the stimulus-situation is keeping the pattern set up. The instant the stimulus is removed the brain-pattern disappears. A memory, a thought, any particular experience whatever is a temporary adjustment of the organism to the particular stimulus-pattern that is acting upon it. Temporary adjustments find no representation in the structure of the brain; they need none in order to *occur;* they need none in order to *recur* . . .
>
> Consider the air in a room and assume, to begin with, that there are no currents. Light a candle and a current of air will be set up. Introduce more candles and the air will be chopped into many currents, all of which must adjust to each other. Now blow out the candles. The currents disappear. The brain is like the air and the candles are like stimuli. Remove the

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[8] In the words of K. W. Spence, ". . . none of the so-called 'field' theories in psychology today have the mathematical properties of those used in physics." Quoted from Moss, F. A., ed., *Comparative Psychology*, 2d ed., New York, Prentice-Hall, 1934, 1942, p. 285, by permission of the publishers.

> organism from stimuli and an analogous process takes place. There are no traces left in the atmosphere. There are none left in the brain, for the brain, in principle, is a fluid field of energy like the air. In one case, the air is necessary for air current; in the other case brain substance is necessary for brain currents, but in neither case are traces involved.[9]

Much as is known about the nervous system, the facts with which to settle this contention are not available. "At the present time, nothing whatever is known concerning the nature of the alterations in the nervous system which constitute memory traces. Knowledge of cerebral physiology is in fact so limited that it does not even lend a greater plausibility to one than to another of the many speculations concerning the organic basis of memory with which the literature is burdened. Association with direction of flow of nervous excitation or with a ratio of excitation is neither more nor less fantastic as a physiological theory than is association between hypothetical conditioned-reflex arcs. The only relevant facts are those of psychology . . ."[10]

It should be noted however that no mention was made by Lashley and Wade of the possibility that an experience leaves no neural trace. It is not surprising that that possibility was not mentioned because of the almost universal belief mentioned in the introductory section that experience does leave its traces. The memory trace is then a hypothetical neurological construct and part of the thinking of most psychologists, not excepting Gestalt psychologists. Koffka found such a construct important in his thinking and not greatly different from some physical concepts.[11] He was of the opinion that Wheeler's position was a denial of a particular kind of trace rather than of the general concept.[12] Köhler also is quite explicit as to the necessity of a trace hypothesis. The details may vary, "But no theory will be acceptable which fails to assume the existence of some trace. . . . All sound theories of memory, of habit, and so forth, must contain hypotheses about memory traces as physiological facts." [13]

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[9] From Wheeler, R. H., and Perkins, F. T., *Principles of Mental Development,* copyright 1932 by Thomas Y. Crowell Company, by permission of the publishers.

[10] From Lashley, K. S., and Wade, Marjorie, "The Pavlovian Theory of Generalization," *Psychological Review,* 1946, 53:72–87, p. 86, by permission of the American Psychological Association.

[11] Koffka, K., *Principles of Gestalt Psychology,* New York, Harcourt, Brace, 1935, pp. 428–431.

[12] *Ibid.,* pp. 457–460.

What the psychologist says in effect is, "I believe the nervous system is changed in certain ways by experience because it is a reasonable supposition and the one which makes the facts of psychology most understandable." [14] There is value in having the facts of psychology ordered or organized around such integrating concepts. The physiological construct may later prove to be untenable, but on the other side of the ledger it may, by permitting deduction, promote psychological observation and investigation.

Emphasis upon Maturation

Why is it that Wheeler and Perkins are in such a minority in regard to the postulation of traces? The answer is that the difference is to a large degree a semantic one. Many psychologists have discarded the idea of the kind of trace to which Wheeler and Perkins take exceptions. What they do then is to continue to use the word "trace" to refer to their revised concept of the physiological modification caused by experience, which in turn is responsible for the modification of behavior (usually called learning) which is later observed. Wheeler and Perkins have not chosen similarly to continue to use the word "trace" with a revision of meaning. But there is good evidence in their book that they make use of similar concepts under the label "maturation." [15] This involves a revision of the word "maturation" of which a reader must be aware. Maturation is at one time identified with learning and at another it is the basic condition of learning. When education is defined as the direction of maturation there is the obvious implication that the course of maturation depends upon educational experience. But they refuse to admit it in so many words; they want no laws which refer to experience, the needed laws they claim are laws of maturation, such as: that parts come into being by emergence from wholes deriving their properties from wholes; their action is determined by the whole; and wholes evolve as wholes. Where Lewin looked primarily to the physical sciences for his nonhistorical laws, Wheeler and Perkins looked primarily to descriptions of biological development.

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[13] From pp. 251–252 of *Gestalt Psychology*, by Wolfgang Köhler, copyright 1947, Liveright Publishing Corporation, by permission of the publishers.

[14] In Chap. V such a change will be referred to as an engram.

[15] See the Wheeler and Perkins (*op. cit.*) index references to the word.

In their emphasis upon maturation as synonymous with structural growth, Wheeler and Perkins are by no means alone. With the tendency to de-emphasize historical explanation, in educational psychology at least, there is more of a tendency to be concerned to describe the biological growth process than to explain behavior in terms akin to those used in physical field laws. And this is understandable. For whereas field laws are easily seen to be no substitute for historical explanation, as Lewin clearly explained, laws of growth appeal to many as a more scientific replacement of traditional learning theory.

The trend is particularly noticeable among specialists in child development.[16] Take Gesell for example. He introduced his discussion of "The Ontogenesis of Infant Behavior" [17] by saying that the infant "comes by his 'mind' in the same way that he comes by his body; namely, through the mechanisms of development. Our task is to formulate some of the general principles which underlie the developmental patterning of his total action system . . .

"The action systems of embryo, fetus, infant, and child undergo pattern changes which are so sequential and orderly that we may be certain that the patterning process is governed by mechanisms of form regulation—the same mechanisms which are being established by the science of embryology . . .

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[16] Olson, W. C., *Child Development*, Boston, Heath, 1949. Pp. 334–338 are devoted to "How Children Learn." See also bottom of p. 5 and top of p. 6.

[17] Reprinted by permission from pp. 295, 297, 298, 313, 316, and 326 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

"It cannot, therefore, be doubted that the general physiology of mental development will find its deeper roots in the same scientific soil which is now intensively cultivated in laboratories of experimental embryology . . ."

After referring to the traditional effort to explain learning, Gesell continues, "Needless to say, these laws (the traditional laws of learning) will some day be reformulated in terms of the biology and physiology of development."

The environment is not denied altogether, just de-emphasized. "The so-called environment, whether internal or external, does not generate the progressions of development. Environmental factors support, inflect and specify; but they do not engender the basic forms and sequences of ontogenesis."

And after referring to Malinowski's characterization of the culture as "a large scale molding matrix," Gesell writes: "His meaning is, of course, clear and up to a certain point incontrovertible; but in the interpretation of child development I should prefer to reserve the term 'matrix' for the maturational mechanisms which literally establish the basic patterns of behavior and of growth career."

And toward the end of the discussion, Gesell makes clear as he did in the introduction that he looks to the ontogenetic principles to be all-embracing. "We have most frequently referred to motor and psychomotor characteristics. This is natural because these so-called motor phenomena are the most objective and measurable. It must not be thought, however, that the ontogenetic principles operate only in the motor sphere. It will be well to inquire whether they do not pervade the total domain of psychological growth, including language, adaptive, and personal-social behavior."

The chapter in the *Manual* was chosen purposely as the Gesell statement which most de-emphasizes the psychology of learning. In a more recent statement [18] a little more is admitted for learning. But even there, after mentioning "learning" in the introductory paragraphs as something other than growth, no further use is made of the word in connection with the references to education. There is a strong implication from the use of the worlds "growth" and "maturation" instead of "learning" that learning is unimportant in development.

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[18] Gesell, A., "Growth Potentials of the Human Infant," *The Scientific Monthly*, 1949, 68:252–256.

Carmichael on the other hand, like Lewin, sees the need for seeking causes in all directions.[19] Developing the implications of the facts of early development, he writes: "It certainly seems more and more certain that, whatever else scientific psychology may do, it must concern itself increasingly with the relationship between the environment external to the receptors, be they exteroceptors, interoceptors, or proprioceptors, and to the responses of the organism to such stimulation."

Summary and Conclusions

With this contrast between Carmichael and Gesell, the analysis of the issue of this chapter is concluded. Explanation of learning in terms of the prior experience of the learner has been described as having been criticized as atomistic, as based upon an untenable neurological hypothesis (the neural trace), and (by implication) as an inferior type of explanation in need of replacement by field theory or by the biological laws of growth. Lashley, Lewin, Koffka, and Köhler were quoted to show that not all who begin with a wholistic premise find it necessary to deny the validity and importance of the historical type of explanation, although there is a tendency to neglect it in the wholistic literature. And although learning is neglected in the literature of child development, Carmichael was quoted to show that not all students of early growth expect explanation to be complete at the biological level.

Few, if any, psychologists would want to differ with Gesell as to the need for a better understanding of growth processes. Likewise few would want to differ with Wheeler and Perkins in their contention that all development, including that involved in formal education, has its physiological growth aspects. The mistake they make is in thinking that explanation at the biological level is sufficient. There is need for explanation of the child as to his genetic origins; his growth as a learning organism needs explanation; his behavior as an energy system needs explanation; *and* especially in educational psychology there is need for explanation of the controllable aspects of his development, i.e., of the relation of his development to psychological or educational controls. In short, the answer to the question in the title of this chapter is a clear "yes." It is "yes" because the different types of explanation, as Lewin maintained, are complementary. No one of these kinds of explanation is a substitute for the others. The answer is especially "yes" if educational need is to be met. The educator has constant need to know what lack of education or other fault of education is responsible for observed disability, maladjustment or asocial behavior. He is in constant need to know whether the experiences of his pupils today are likely to contribute to development in the directions sought for tomorrow.

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[19] Reprinted by permission from p. 140 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

There is too much denial for the sake of emphasis—denial of status as science, denial of validity, and denial of importance. It is reminiscent of the tendency in behaviorism to reject all, or to ignore all that did not lend itself to the new approach. The "Gestalt" movement in general psychology and the "growth" movement in child development need careful appraisal in this connection by the student who seeks to answer for himself the question posed for this chapter.

The author's answer to the question could have been anticipated. The use of the word "learning" in the title of this book suggests a study of development in its psychologically or educationally controllable aspects. In chapter one it was emphasized that explanation in terms of prior experience must find a place if the needs of education are to be served. In a very real sense this chapter has been a critical examination of the claim for the importance of learning made in chapter one.

At the end of the previous chapter, the need was described as a need for a psychology of learning based upon a wholistic premise. Now the direction of the needed explanatory effort may be further described. That decision to start from a wholistic premise need not and should not be thought of as an effort to avoid as thoroughly as possible all that has been associated with a more atomistic approach. On the contrary, the need is to revise and incorporate into a system based upon a wholistic postulate, all of the useful contributions of more atomistic approaches. The position taken is that there is an element (!) of validity in the observations even of James Mill.

A psychology of learning, in emphasizing historical explanation, need not be atomistic. The fact that it includes a postulation of physiological traces does not make it atomistic. Whether such physiological constructs are atomistic or not depends upon the kind of trace postulated. The most that can be said against the postulation of physiological traces as a part of learning theory is that such a postulation may be gratuitous, in other words, that it may serve no constructive purpose.

The way is now clear for a consideration of the third issue. The question of elements in chapter two came first as a necessary background for the present chapter. Only for those who have found no place for historical explanation is the next issue unimportant. For the others, whether committed to a wholistic approach or not, explanation in terms of effects is an important issue.

CHAPTER IV

EXPLANATION IN TERMS OF EFFECTS?

What Is Meant by "Effects"?
The Law of Effect
Modification of the Law of Effect
Criticism of the Modification
The Law of Effect as Reinforcement
Is Reinforcement Necessary for Learning?
Nonreinforcement Theories
Summary and Conclusions

What Is Meant by "Effects"?

If the learner in a given situation may do any one of several things, but one is found to be followed by pleasurable consequences, that course is likely to become the preferred one. On the other hand, the response which brings painful consequences is likely to be made less frequently. This is explanation of learning in terms of effects. Some of the terms for effects which in this way have been paired are: a state of well-being on the one hand, and discomfort on the other; satisfaction and annoyance; reward and punishment; being told of correctness and being told of incorrectness; and success and failure or frustration.

Explanation of this sort is often called a pleasure-pain theory of learning because pleasure and pain were the words used in the early history of such explanation. But a pleasure-pain explanation of learning is not the same as hedonism. There was much thinking about pleasure and pain as values and about pleasure and pain as motives before pleasure and pain as effects were used as explanatory concepts in learning theory.

It seems a mistake to cite[1] a remark like Locke's as an example of the pleasure-pain theory of learning illustrated above, for what Locke[2] said was that "Attention and repetition help much to the fixing any ideas in the memory; but those which naturally at first make the deepest and most lasting impression are those which are accompanied with pleasure or pain." In other words, pleasure and pain operated alike according to Locke, their function being to make one take notice of things. But before 1875 explanation of learning in terms of pleasure and pain as effects was explicit,[3] and before 1900 it was common.[4]

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[1] Pyle, W. H., "Origin of the Pleasure-Pain Theory of Learning," *Journal of Educational Psychology*, 1933, 24:303–304.

The Law of Effect

In 1905 Thorndike[5] referred to the pleasure-pain influence upon learning sometimes as the Law of Habit Formation, sometimes as the Law of Effect. By 1911,[6] it was evident that he preferred to call it the Law of Effect, and in 1913[7] this law appeared in his *Educational Psychology* with the same title, and worded as follows: "When a modifiable connection between a situation and a response is made and is accompanied or followed by a satisfying state of affairs, that connection's strength is increased:

Cason, H., "The Pleasure-Pain Theory of Learning," *Psychological Review*, 1932, 39:440–460.
Cason, H., "The Origin of the Pleasure-Pain Theory of Learning," *Journal of Educational Psychology*, 1933, 24:475–477.

[2] Locke, J., *An Essay Concerning Human Understanding*, Book 2, Chap. 10, Sec. 3.

[3] Bain, A., *The Senses and the Intellect*, 3d ed., London, Longmans, Green, 1868, pp. 300–306.
Spencer, H., *The Principles of Psychology*, New York, Appleton, 1872, Vol. 1, p. 280.

[4] Baldwin, J. M., *Mental Development in the Child and the Race*, New York, Macmillan, 1894, pp. 170–204.
James, W., *Principles of Psychology*, New York, Holt, 1890, Vol. 2, p. 550.
Morgan, C. L., *Introduction to Comparative Psychology*, London, Scott, 1894, p. 176.
Thorndike, E. L., "Animal Intelligence: An Experimental Study of the Associative Processes in Animals," *Psychological Review. Monograph Supplements*, 1898, Vol. 2, No. 4.

[5] Thorndike, E. L., *The Elements of Psychology*, New York, Seiler, 1905, pp. 166, 199–205.

[6] Thorndike, E. L., *Animal Intelligence: Experimental Studies*, New York, Macmillan, 1911, p. 244.

[7] Thorndike, E. L., *Educational Psychology*, Vol. 2, *The Psychology of Learning*, New York, Teachers College, Columbia University, 1913.

When made and accompanied or followed by an annoying state of affairs, its strength is decreased."

By the time this statement appeared there was a strongly felt need for objectivity. Thorndike had been very influential in this respect. Although he used words like "satisfaction" and "annoyance" which have mentalistic meaning, he had made it clear from the outset [8] that he was talking about behavior. And in the 1913 work he defined his terms as follows: [9] "By a satisfying state of affairs is meant roughly, one which the animal does nothing to avoid, often doing such things as attain and preserve it. By an annoying state of affairs is meant roughly, one which the animal avoids or changes."

But Thorndike did not always receive credit for his objectivity. Some thought that his Law of Effect was still the early associationist's pleasure-pain theory without objective meaning which as appropriately or more appropriately could be called a Law of Affect.[10] Cason,[11] for instance, thought the Thorndike definitions quoted in the preceding paragraph were circular; that to introduce them into the Law was as if Thorndike were saying that the animal learns what it does and avoids what it does not do. To put it this way is to fail to get the meaning which the "definitions" add. The definitions get their meaning from the descriptions of the behavior of the cats, dogs, chickens, fish, and monkeys which Thorndike used as subjects. With the behavioristic meanings for his law and for his definitions which are provided by his earlier descriptions, the law informs that any early response in a series of responses which are made one after the other in a tense manner, and without letup or relaxation, is less likely to be made on another similar occasion than is the response which is followed by lowered tension and absence of quick turning from one thing to another. The "law" of effect may not have been a law; it may not have been an explanation; it *was* a behavioristic empirical generalization concerning animal learning.

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[8] Thorndike, E. L., "Animal Intelligence; An Experimental Study of the Associative Processes in Animals," *Psychological Review. Monograph Supplements,* 1898, Vol. 2, No. 4, pp. 97–99.

[9] Reprinted by permission from p. 123 of *Educational Psychology,* Vol. 1, *The Original Nature of Man,* by E. L. Thorndike, New York, Bureau of Publications, Teachers College, Columbia University, 1913.

[10] Hollingworth, H. L., "Effect and Affect in Learning," *Psychological Review,* 1931, 38:153–159.

[11] Cason, H., "The Pleasure-Pain Theory of Learning," *Psychological Review,* 1932, 39:440–466. See p. 462.

Modification of the Law of Effect

The position to be taken later in this chapter and in the following chapter is that this Law of Effect is still a valid empirical generalization. It will not appear in chapter five as a law of effect but, in presenting a description of learning there, it will be considered necessary to account not only for what reward does, but for what punishment does. Because of this fact, the reader now needs to be warned that this position is and will be taken in the face of contrary opinion and of an impressive body of evidence. In later sections of this chapter, the reasons for not accepting the contrary evidence will be presented. But first, what is the nature of the evidence?

In the late twenties, Thorndike conducted an intensive series of experiments in the field of learning, the results of which were published as a series of lectures in 1931 [12] and with the supporting data in 1932.[13] The Law of Effect received major attention because of its importance in Thorndike's thinking, and because others had given it so much critical attention.[14]

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[12] Thorndike, E. L., *Human Learning*, New York, Century, 1931, Lectures 3, 4, 5.

[13] Thorndike, E. L., *The Fundamentals of Learning*, New York, Bureau of Publications, Teachers College, Columbia University, 1932. Chaps. 9 to 12 inclusive.

[14] Carr, H. A., Tolman, E. C., Thorndike, E. L., Culler, E. A., Dashiell, J. F., and Muensinger, K. F., "The Law of Effect: A Round Table Discussion," *Psychological Review*, 1938, 45:191–218.

McGeoch, J. A., *The Psychology of Human Learning*, New York, Longmans, Green, 1942, Chap. 14.

Postman, L., "The History and Present Status of the Law of Effect," *Psychological Bulletin*, 1947, 44:489–563. In connection with which see also *Psychological Bulletin*, 1948, 45:151–160, 344–345, 536–537; and *Psychological Bulletin*, 1949, 46:51–53.

Reference to the results is sometimes made in terms of reward and punishment and sometimes in terms of satisfaction and annoyance. More precisely, in most of the experiments the subject who was to learn was told "Right" when he made a correct response and "Wrong" when he made an incorrect response.

Thorndike chose to investigate the influences of satisfaction and annoyance in a multiple-choice situation. There was good reason for this choice. When learning takes place where there are only two possible responses, one cannot be sure whether "wrong" helps directly by weakening the tendency to make the wrong response or indirectly by enabling the learner to identify the correct response. But if there are several wrong responses and the learner, without locating the correct response, avoids the wrong response he has made, the correct response cannot be said to have had anything to do with the learning. Under these circumstances any weakening of the tendency to make the incorrect response occasioned by being told "wrong" can be evaluated without ambiguity.

Here is a very brief description of the method and results of the experiments quoted from a Thorndike article: [15]

> The general plan of all the experiments is the same. In every case the person may do any one of several things, of which one is right and the rest wrong. If he does the right thing, he is then and there rewarded. If he does the wrong thing, he is then and there punished. For illustration here I will take cases where there are five acts possible. Call them *R* (the right one) and *X1, X2, X3,* and *X4* (the four wrong ones). For example, I show the person a German word followed by five English words, one of which is

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Rice, P. B., Mowrer, O. H., and Allport, G. W., "Symposium: The Ego and the Law of Effect," *Psychological Review,* 1946, 53:307–347.

Stephens, J. M., *The Influence of Different Stimuli upon Preceding Bonds: An Examination of the Law of Effect, Columbia University Contributions to Education, No. 493,* New York, Teachers College, 1931.

Thorndike, E. L., *The Fundamentals of Learning,* New York, Bureau of Publications, Teachers College, Columbia University, 1932, pp. 439–482.

Waters, R., "The Law of Effect as a Principle of Learning," *Psychological Bulletin,* 1934, 31:408–425.

[15] Thorndike, E. L., "Psychology and Engineering," *Mechanical Engineering,* 1932, 54:30–34, p. 34. Quoted by permission of the American Society of Mechanical Engineers.

> the correct translation, the other four being wrong. He chooses one of the five, and is rewarded if it is right and punished if it is wrong. We do the same for one hundred ninety-nine other German words, and then repeat the two hundred, and so on until many or all are learned.
>
> The extraordinary result is that in such cases the punishments do no good whatever. Punishing *X1*, or *X2*, or *X3*, or *X4* does not make it less likely to occur. The person improves only because of the rewards for *R*. If the person does *R* and is rewarded he is more likely to do *R* the next time. But if he does *X1* and is punished, he is not less likely to do *X1* the next time. The wrong tendencies are not reduced in strength one jot or tittle by the punishment. If the person gets rid of them, it is simply and solely because the *R* tendency becomes so strong that it displaces *X1*, *X2*, *X3*, and *X4*. All the improvement in these experiments is due to the rewards.

Thorndike's opinion concerning the influence of punishment did not change in later years. Eleven years after the above quoted description appeared, his opinion, well expressed in a single sentence, was, "Unless punishing the wrong somehow causes confirmation of the right, we may be suspicious of its efficacy." [16] And in his *Selected Writings* [17] the interpretation is the same: "Any apparent subtraction is due to the increased strength of competing tendencies . . . They (punishments) weaken the connection which produced them, when they do weaken it, by strengthening some competing connection . . . A better fit to the observed facts is obtained in every case by crediting a punished occurrence with zero influence or a slight positive influence than by crediting it with a negative influence, no matter how slight."

Criticism of the Modification

At this point it is necessary to add to the above quoted description of Thorndike's procedure. Having the results indicated from his description, he counted the number of "Wrong" responses on one trial which were repeated on the following trial, and expressed as a percentage the ratio of repeated "Wrongs" to the total number of "Wrongs" which might have been repeated. Similarly, the number of repeated "Right" responses was expressed as a percentage of the total number of "Right" responses which might have been repeated. He then asked whether "Right" on one trial had caused the subjects on the next trial to repeat the responses which it had followed, and whether "Wrong" had caused them to avoid the responses which it had followed. The question is, how large a percentage of repetition did he need to find in order to prove that "Right" had had the expected strengthening influence, and how small a percentage of repetition did he need to find in order to prove that "Wrong" exercised its supposed weakening influence?

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[16] Thorndike, E. L., *Man and His Works*, Cambridge, Mass., Harvard University Press, 1943, p. 156, by permission.

[17] Thorndike, E. L., *Selected Writings from a Connectionist's Psychology*, New York, Appleton-Century-Crofts, 1949, pp. 18, 38, 48, by permission.

It is at this point that Thorndike's procedure is considered to have been at fault. He *assumed* that without the influence of either "Right" or "Wrong" the learners would have repeated their responses in accordance with the laws of chance. In terms of his illustration, above, each learner on each trial would have made two hundred responses, choosing one of the five words on each of the two hundred lines. By chance he would on the next trial repeat 20 per cent of his first trial responses. But if a learner for some reason (it need not be a belief in its correctness) has a favorite here and there as he runs through his trial, then he may be expected to repeat more than a chance percentage of his responses.

For one set of experimental conditions Thorndike recognized this need "to obtain the strength of the various tendencies apart from any reward or punishment." [18] It would seem that in any long list of multiple-choice situations a given learner would have some such preferences. On a given line one learner might prefer the second, another the third, and so forth. The presence or absence of individual favoritism could therefore not be tested by noting whether or not the group's responses were spread evenly among the five possibilities. The only way to know how much repetition is to be expected aside from the influence of "Right" and "Wrong" is without telling the learner when he is right and when wrong, to run through two or more trials, to count the number of responses on one trial which are repeated on the next trial.

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[18] From Thorndike, E. L., *The Fundamentals of Learning*, New York, Bureau of Publications, Teachers College, Columbia University, 1932, p. 311, by permission of the publishers.

Without such an empirical determination for each experiment, Thorndike's data may have been evaluated in a very misleading manner. Suppose, for instance, that Thorndike found that "Right" responses were repeated 45 per cent of the time, and that "Wrong" responses were repeated 25 per cent of the time. Following his procedure, he would assume a chance amount of repetition, namely 20 per cent, as a point from which to measure. That would yield a supposed strengthening influence for "Right" of forty-five minus twenty. The learners were repeating the responses followed by "Right" more frequently than might be expected by chance. On the other hand, responses followed by "Wrong" instead of being avoided, that is, repeated less than 20 per cent of the time, were actually being repeated more often than chance would lead one to expect. But instead of proceeding on the basis of an assumption, suppose Thorndike had found out just how often the learners were repeating their responses, without any "Right" or "Wrong" to influence them, and that 35 per cent of their responses were being repeated under those circumstances. The influence of "Right" would then be measured as forty-five minus thirty-five, or ten, in the direction expected, and the influence of "Wrong" would be measured as thirty-five minus twenty-five, or ten, also in the direction expected.

There is reason [19] for thinking that Thorndike would have found just such results, at least that he would have found less of a case for "Right" [20] and more of a case for "Wrong" had he obtained a more defensible point from which to measure.[21]

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[19] Brown, W., "Punishment Does Work," *Journal of Comparative Psychology*, 1937, 24:145–146.
Goodenough, F., "A Note on Tolman's 'Disproof' of Thorndike's Law of Effect," *Journal of Experimental Psychology*, 1933, 16:459–462.
Hull, C., "Special Review: Thorndike's *Fundamentals of Learning*," *Psychological Bulletin*, 1935, 32:807–823.

Had Thorndike secured empirically determined reference points from which to measure influence and found any avoidance of "Wrong" responses he would not have made a statement which he frequently did make to the effect that "any apparent subtraction is due to the increased strength of competing tendencies." [22] As was stated above, he chose to experiment with a multiple-choice situation knowing full well [23] that in it the avoidance of a wrong could not be attributed to the influence of "Right."

The Law of Effect as Reinforcement

Hull's influence has brought about a preference for the use of the word "reinforcement" [24] to refer to the law of effect as it was modified by Thorndike. Hull pointed out that the satisfying state of affairs responsible for habituating a response is not al-

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Muensinger, K. F., "Motivation in Learning, II. The Function of Electric Shock for Right and Wrong Responses in Human Subjects," *Journal of Experimental Psychology*, 1934, 17:439–448.

Muensinger, K. F., in the round table referred to above. *Psychological Review*, 1938, 45:217.

Stephens, J. M., "The Influence of Punishment on Learning," *Journal of Experimental Psychology*, 1934, 17:536–555.

Tilton, J. W., "The Effect of 'Right' and 'Wrong' Upon the Learning of Nonsense Syllables in Multiple Choice Arrangement," *Journal of Educational Psychology*, 1939, 30:95–115.

[20] For, if his measures of the potency of "Wrong" were in error by being too small, his measures of the potency of "Right" were correspondingly too high.

[21] That punished responses may be learned does not disprove that, other things being equal, punishment tends to weaken the tendency to respond as punished. Tolman, E. C., Hall, C. S., and Bretnall, E. P., "A Disproof of the Law of Effect and a Substitution of the Laws of Emphasis, Motivation, and Disruption," *Journal of Experimental Psychology*, 1932, 15:601–614.

[22] Quoted above.

[23] Thorndike, E. L., *The Fundamentals of Learning*, p. 277.

[24] The term had been used frequently.

James, William, *Principles of Psychology*, Vol. 2, p. 550.

Morgan, C. L., *An Introduction to Comparative Psychology*, p. 176.

Pavlov, I. P., *Conditioned Reflexes* (translated by G. V. Anrep), London, Oxford, 1927.

It was in fact used by Thorndike, *Psychological Review*, 1933, 40:439, though he usually spoke of a confirming reaction.

ways related to the habituated response as is effect to cause.[25]

In his use of the word, Hull identified reinforcement with goal or need reduction. Thus Hull anchored the reinforcement process more explicitly and more definitely to motivation than had Thorndike. Thorndike made it clear that he did not identify his confirming reaction with concepts like the maintenance of equilibrium or the reduction of tensions.[26] He showed no disposition to change his definition of "a satisfying state of affairs." [27]

There was no difference worthy of note between Thorndike and Hull concerning the apparent backward action of the law.[28] The law was often criticized because in it an effect was in turn described as a causal agent to account for changes in what caused the effect. Thorndike [29] thought it quite reasonable for neural traces to exist long enough to be so affected, as did Hull.[30]

For Hull and for many learning-theorists, reinforcement is the basic concept of learning. The activity out of which learning comes is of a trial and error nature. From this point of view, learning is the selection for more frequent use of one or some of the many responses made in the early trials. The selection is brought about for the selected response when it is associated in time with (a) the reduction or diminution of a native drive or goal, or (b) in the case of a more sophisticated learner with a learned substitute for a native drive reduction.[31] Basically, then, from this point of view, learning is a process of reinforcement.[32]

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[25] National Society for the Study of Education, *41st Yearbook*, p. 65; also Hull, C., *Principles of Behavior*, New York, Appleton-Century, 1943, pp. 80–81.

[26] Thorndike, E. L., *Man and His Works*, Cambridge, Mass., Harvard University Press, 1943, p. 33.

[27] Quoted earlier in this chapter from his 1913 work. He repeated it in 1933. Thorndike, E. L., "A Theory of the Action of the After-Effects of a Connection Upon It," *Psychological Review*, 1933, 40:434–439.

[28] Woodworth, R. S., *Contemporary Schools of Psychology*, rev. ed., New York, Ronald, 1948, p. 53.

[29] Thorndike, E. L., *The Fundamentals of Learning*, p. 327.

[30] Hull, C., *Principles of Behavior*, pp. 41–42.

[31] *Ibid.*, Chaps. 6, 7.

[32] *Ibid.*, p. 71.
For a more popular treatment, see Miller and Dollard, *Social Learning and Imitation.*

Is Reinforcement Necessary for Learning?

However, the essence of learning is not always so described. And that raises the second, and more important issue concerning explanation in terms of effects. Is reinforcement the basic fact of learning? Is it the keystone in the theoretical arch? Is learning always attributable to reinforcement? It is quite understandable that the comparative psychologist should emphasize the relation between learning and goals. He almost invariably prepares his animal subjects for the observation period by providing deprivation, confinement, or pain. Under these circumstances learning is attributed to getting food, drink, access to the mate, freedom, or away from the source of pain. But may not the comparative psychologist be taking a limited view of human learning? Without in the least minimizing the importance of describing the learning of animals when so motivated, it must be asked whether all human learning can be so identified with goal reduction. In fact it may be asked whether all the learning of lower animals can be so identified.

Consider the data reported by Blodgett.[33] He reported that a group of rats with two unreinforced trials from which the rats made very little progress in running rapidly and without error to the goal box, and four reinforced trials, performed as well as the control group did with the learning from six reinforced trials. Another experimental group after six unreinforced trials with apparently little learning and two reinforced trials did as well as the same control group after its six reinforced trials. In another maze, an experimental group, after sixteen unreinforced runs and one reinforced run, performed as well as the control rats did after twelve reinforced runs. In other words, when the experimental rats were fed in the goal box as the control rats were, the experimental rats "learned" the maze more rapidly than the control rats had.

[33] Blodgett, H. C., "The Effect of the Introduction of Reward Upon the Maze Performance of Rats," *University of California Publications in Psychology*, 1928–1931, Vol. 4, pp. 113–134.

These results were offered with considerable confidence, because they almost passed the test of statistical significance which statisticians conventionally require, and because great care had been used to have comparable groups. Data in three earlier studies, cited by Blodgett, had suggested such a finding, but these earlier studies provided inadequate controls. This finding in Blodgett's study, and in similar studies of learning without reinforcement, is usually referred to as *latent learning*. Blodgett called it that because it is not manifest until the rats show by their later more rapid improvement that they had gotten considerable advantage from their unreinforced activity. The term is unfortunate. It implies that it isn't learning till the experimenter has proof of it. It is like saying that pupils get only latent learning from day to day and then at the end of the term, during the examination, learn all the correct responses they make on the examination. If the data mean what they appear to mean, it is better to say that animals learn in a strange situation whether the experimenter knows it or not and without his being able to relate the learning to drive reduction. Motivation and reward in such a case are the experimenter's means of getting the animals to demonstrate what they have learned rather than factors responsible for learning. They are his way of telling the rats to run swiftly to the goal box. And just as soon as the experimenter stops rewarding the rats in the goal box, the rats stop running speedily and without error to the box.[34] It is therefore necessary to distinguish between reinforcement as an explanation of learning and reward as motivation, between what accounts for learning and what accounts for performance. This the Law of Effect does not do.[35]

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[34] Elliott, M. H., "The Effect of Change of Reward on the Maze Performance of Rats," *University of California Publications in Psychology*, 1928–1931, 4:19–30.
Bruce, R. H., "The Effect of Removal of Reward on the Maze Performance of Rats," *University of California Publications in Psychology*, 1928–1931, 4:203–214. Sharp, W. S., "Disintegrative Effects of Continuous Running and Removal of the Food Incentive Upon the Maze Habit of Albino Rats," *Journal of Comparative Psychology*, 9:405–423.
Tolman, E. C., and Honzik, C. H., "Introduction and Removal of Reward and Maze Performance in Rats," *University of California Publications in Psychology*, 1928–1931, 4:257–275.

Tolman and Honzik, in the study cited above, confirmed Blodgett's finding of unreinforced learning, but the finding is not always corroborated. Spence and Lippitt[36] reported two experiments, one showing evidence of learning without reinforcement and the other failing to show such evidence. Later they reported[37] additional experimental data which did not support a nonreinforcement theory. These and similar data suggest that "latent" learning may not be expected regardless of the motivational factors and rewards involved. "Latent" learning data seem to call for a recognition both of the importance of reinforcement as a principle of learning, and of its limitations.

Moehl and MacCorquodale[38] clearly define the issues thus: ". . . Granted that reinforcements are able to *dominate* cognitions the crucial issue between a pure reinforcement theorist and a sign-learning theorist is in the insistence of the former that reinforcement is a necessary condition for the acquisition of response strength." They then present data for which they offer a modified reinforcement explanation, concluding that "It must be emphasized that the reinforcement type of explanation given here applies only to the special form of 'latent learning' *in which the incentive is present* during the cognition training. It is obvious that the Blodgett type of design (to which the term 'latent learning' was originally applied) requires some other treatment —if indeed it can be handled by reinforcement theory at all."

But even under complex conditions with regard to motivation and reward, evidence for "latent" learning is not always lacking.[39] Hence, though the meaning of "latent" learning is an issue, "as an experimental fact it appears to be securely established." [40] And, if one accepts it, he seems obliged to view learning in a larger perspective than is embraced in a description in which learning is contingent upon reinforcement. Seward,[41] in modifying Hull's theory to embrace the facts of "latent" learning begins by "modifying" Hull's principle of reinforcement, but the modification is so drastic as to amount to a negation and a substitution.

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[35] Lashley, K. S., "Learning: III. Nervous Mechanisms in Learning," which is Chap. 10 in C. Murchison, ed., *A Handbook of General Experimental Psychology*, Worcester, Mass., Clark University Press, 1934, p. 486.

[36] Spence, K. W., and Lippitt, R. O., " 'Latent' Learning of a Simple Maze Problem with Relevant Needs Satiated," *Psychological Bulletin*, 1940, 37:429.

[37] Spence, K. W., and Lippitt, R. O., "An Experimental Test of the Sign-Gestalt Theory of Trial and Error Learning," *Journal of Experimental Psychology*, 1946, 36:491–502.

[38] Moehl, P. E., and MacCorquodale, K., "A Further Study of Latent Learning in the F Maze," *Journal of Comparative and Physiological Psychology*, 1948, 41:372–396. See pp. 372, 395. Quoted by permission of the American Psychological Association.

At this point it must be recognized that in a sense all behavior is motivated. In this sense motivation plays a part in all learning. But if one must resort to this attenuated meaning of motivation in order to say, as is often said in educational literature, "no motivation, no learning," what has been said? One might as well say "no living, no learning." The observation offers too little. Motivation is the goal-directedness of behavior. And even if all behavior is on a continuum as to the extent to which it is goal-directed, the word motivation is *practically* useful only toward the highly goal-directed end. For practical purposes we may speak of some behavior as not motivated.

It must be granted, of course, that the goal-directedness of behavior is a most important consideration in psychology and in education. However, this importance is not a sufficient justification for ignoring the nature of the learning process when goal direction is an unimportant factor. We must not allow the great importance of motivation to prevent us from studying the nature of the learning process when motivation is negligible. To do so would be to ignore an opportunity for seeing the learning process in its most basic aspects.

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[39] Deisenroth, C. E., and Spence, K. W., "An Investigation of the Problem of Latent Learning in the White Rat," *Psychological Bulletin*, 1941, 38:706–707.

[40] From p. 287, Hilgard, E. R., *Theories of Learning*, New York, Appleton Century-Crofts, 1948, by permission of the publishers.

[41] Seward, J. P., "A Theoretical Derivation of Latent Learning," *Psychological Review*, 1947, 54:83–98. See pp. 85–86.

Nonreinforcement Theories

The need for a "nonreinforcement" theory is not traceable exclusively to the finding of "latent" learning data. There have been many explanations which do not include a "law" of effect or a "law" of reinforcement, or at least which assign them to secondary roles. Such nonreinforcement explanations started to appear before "latent" learning was an issue.[42] J. B. Watson was among the earliest of those who have explained in terms of frequency and recency. Carr stands out among those who have emphasized the importance of intensity. Guthrie prefers to describe the selection and elimination of responses in a trial and error situation as simply a matter of replacement or nonreplacement. The "errors" are always replaced by other responses, the "successful" response is not replaced. For reasons mentioned in chapters two and three, Gestalt psychology does not emphasize a law of effect or of reinforcement. Tolman, who stands out as one who is concerned about a larger synthesis, does not believe that all learning is contingent upon reinforcement. However, he does see a place for strengthening by reinforcement (need reduction) and weakening by nonreinforcement.[43]

These "nonreinforcement" explanations are not mentioned with the idea of giving an impression of one-sidedness about this issue. No attempt has been made to count yeas and nays nor to evaluate reputations. The appeal in this and preceding chapters has been made rather to a criterion of educational need and a consideration of *all* the facts. But however the reader resolves the issues of this chapter, he can find stout support for his position. In a symposium, cited above,[44] Mowrer wrote: "I concur fully in Rice's judgment that, despite the unresolved difficulties which remain, the law of Effect is by all odds the most inclusive and predictively potent conception of learning which we have, and should be pushed to its limit." And in the same symposium, Allport wrote: "My own argument holds that the vagueness that must result from extending the principle of satisfaction to cover all of the phenomena of learning (at the higher level of complexity) is such as to disqualify it as a 'law.' At certain low levels of mechanical learning, it may suffice; but at the adult human level, satisfaction is at best a *cue,* of quite secondary importance, and often disregarded."

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[42] Watson, J. B., *Behavior: An Introduction to Comparative Psychology*, New York, Holt, 1914, Chap. 7.

[43] Tolman, E. C., "There Is More Than One Kind of Learning," *Psychological Review*, 1949, 56:144–155. See pp. 146–147.

[44] From pp. 334, 347 of Rice, P. B., Mowrer, O. H., and Allport, G. W., "Symposium: The Ego and the Law of Effect," *Psychological Review*, 1946, 53:307–347, by permission of the American Psychological Association.

Summary and Conclusions

In this chapter the principle of reinforcement was described as half of the original law of effect. Reinforcement is Thorndike's satisfying state of affairs with one qualification. For Thorndike, it was defined in terms of quiescent behavior. But for most users of the word "reinforcement," the term is thought of either as reduction of physiological need or of a learned substitute.

Because of a weakness in the evidence upon which it was based, objection was taken to the modification of the law of effect which reduced it to a principle of reinforcement. It was maintained that considerable doubt exists as to the correctness of the current denials that punishment deters.

More important for a theory of learning, reinforcement was found to be challenged as the necessary and key factor responsible for all learning. It was found to be challenged even on the basis of data concerning the learning of rats in mazes. It is believed to be much more inadequate as the key concept of all of the human learning involved in education.

What is needed in the description of the learning process is an enlargement of perspective and a revision of basic premises, in which due account is taken of the important relation of motivation to learning. No attempt in this direction is in order at this point since the description needed rests upon considerations presented in chapters one to three as well as upon those in the present chapter. Chapter five is an effort to make the needed modification and integration.

PART II

THE LEARNING PROCESS

IN PART I an attempt was made to reduce to some order the difficulty faced by the student of education who seeks a better understanding of the learning process. It was suggested that he examine all descriptions of learning (1) as to their applicability in the areas of development which are educationally most important, (2) as to the stand taken (stated or implied) in regard to the issue of atomism versus wholism, (3) as to the use made of historical and nonhistorical explanation, and (4) as to the emphasis placed upon the concept of learning as the strengthening of connections.

The student's next step, if it has not been taken already, is to choose or to write a tentative general description of the learning process. This is preferable to a more inductive approach. It is better to generalize immediately with awareness of the reasons for each step, and then to check the hypotheses with data, modifying the concept from time to time as necessary.

Anyone engaged in this task profits by carefully comparing his own thinking with the thinking of others similarly engaged. Part II offers such an opportunity. Chapter five is a general statement of the author's working hypotheses. Chapter six makes explicit the relation of these hypotheses to problem solving. Chapter seven does the same for the objectives sought through practice, and chapter eight for the area of adjustment. It is assumed that the student of education will be particularly concerned to find in his understanding of the learning process as much help as possible not only in the school's traditional effort, but also in all efforts to enhance intelligent and good living.

CHAPTER V

A GENERAL DESCRIPTION OF LEARNING

An Outline Statement
Psychological Unity
A Core of Concentration
Continuity and Segmentation
The Cue
Learning Is Cue Production
Knowing What Is Focal in Response
The Basic Importance of Learning
Learning and Meaning
Not a Merely Cognitive Concept
Kinds of Learning
Documentation?

An Outline Statement

This entire chapter is devoted to the amplification of a five-sentence description of behavior as related to learning. No general comment will be made at this point by way of introduction, except to remind the reader of the author's frame of reference as presented in Part I. The opinion was expressed there that description should be consistent with a wholistic position. At the same time it was claimed that any tenable picture must be eclectic in the sense that it should embrace all the useful observations which have been made by those proceeding along atomistic or "as if" lines. No one would want to make a case for eclecticism as a loosely knit or disjointed account. It was, in fact, maintained that integration is highly important. The likelihood of a psychology of learning being used depends in no small measure upon the extent to which learning can be described in meaningfully unified terms. And use, to meet the needs of the educational situation, is the top-ranking criterion.

Because of that criterion, the position was taken that "historical" explanation in learning theory is very important. It was noted that there is a danger of losing sight of this importance because of the tendency to emphasize as *all*-important, field theory on the one hand, and growth or maturation on the other. One should not make his case for the importance of his field of inquiry by thoughtlessly de-emphasizing another approach. In this belief, the importance of having a knowledge of nonhistorical laws is acknowledged. The importance of describing the growth process is also acknowledged. Such knowledge is related in an important manner to education. But it must be insisted upon that the bearing of past experience upon present behavior and of present experience upon future behavior is an essential consideration in education. The psychology of learning is by definition an attempt to describe the control so exercised.

However, the term "learning" as it will be used does not embrace all the changes in man which are related to his behavior. It is not proposed to explain the changes which come with fatigue, or with rest, nor the changes which involve sensory adaptation, as when sight improves after a short time in a dark room. Shall we say that the term "learning" pertains to or embraces the more permanent changes in the behavior in man? That will not do, for some of the permanent changes in man's behavior, such as are due to the loss of sight or of hearing, are excluded. Also excluded are changes due to a disease affecting the brain or other parts of the nervous system. These will not be referred to as learned. But with these exceptions, learning embraces the changes in behavioral tendencies which are environmentally controllable.

Finally, it was concluded that a psychology of learning fails to meet educational needs if it takes its cue too exclusively from the puzzle box, the conditioning of reflexes, and the laboratory maze. The infant, the child, the youth, and even the adult need direction in some areas of learning which have their close parallels in comparative psychology. But there is so great an amount of human learning which is believed to be poorly described in terms of reinforcement that a broader perspective seems needed.

Even in the case of rats, the data indicate the need to recognize important aspects of learning not easily relatable to reinforcement.

These were some of the considerations that led to the following set of five generalizations concerning behavior as related to learning.

1. Behavior is psychologically unified.
2. Within behavior there is usually a core of concentration.
3. Behavior has psychological continuity except as it is segmented into psychological units by a shift in the nature of the core.
4. Behavior is a resultant of influences, including the engrammatic [1] influence of prior experience.
5. The activation of the core of an engram tends to reactivate the whole engram.

Psychological Unity

As observers, we are in the habit of picking behavior to pieces, noting the aspects in which we are interested, and neglecting the others. The present description of behavior as related to learning is first of all a caution against this habit. *Our interest* in certain details does not give them *independence* of the other aspects of the behavior of the learner. We will have a better understanding if we keep this fact in mind. What the learner is doing may be analyzed into many fragments by us as observers, but this fragmentation must not keep us from realizing that functionally the learner's behavior is unified.

We will not mention S_1 leading to R_1 and S_2 leading to R_2 with the implication that all other S → R "units" are irrelevant. We will not seek to explain how it is that S_1 may lead to R_2. We start with the belief that all such interrelationships are a part of the behavior in the first place.

In fact, when one begins with the postulation of the unified nature of behavior he is struck with a change in the nature of his search. Instead of searching for reasons for interrelationships, one seeks for reasons why all the possible "interrelationships" cannot be depended upon. The author's whole position described above in outline and amplified below may be characterized as somewhat of a reversal of the more traditional search. The approach has been to ask the question, "Why *does* learning take place?" Starting with a wholistic postulate makes the search to a much greater extent the search for the answer to the question, "Why is it in certain situations that learning does *not* take place?"

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[1] See Chap. III, concerning the use of the word "engram."

In order to answer the question, one turns immediately to modifications of the wholistic postulate which is the point of departure. You cannot get far with it alone, as Guthrie pointed out after granting its truth. ". . . any attempt to predict from the total situation is hopeless. 'A,' the antecedent term in our general formula for scientific laws, cannot be a total situation because total situations are never repeated, and science cannot deal with events that are unique. We can deal only with recurring aspects of events." [2] In the following postulates the first and basic wholistic premise is supplemented. The postulates added are in no way inconsistent with the first and basic premise. Together, they include all that is good and useful from a more atomistic approach, with a more valid wholistic meaning.

A Core of Concentration

The first step in this direction is to recognize that any dynamic, fluid, or field process is unequally concentrated or intense throughout. There is likely to be a region of greatest intensity, a region of least intensity, and a graduation of intensity between. The gradient may be expected to vary in steepness from those occasions which are referred to as extreme concentration to those in which gradients are difficult to recognize.

Under this postulated gradation of intensity or concentration may be listed all the observations that have been made concerning the importance of the intensity of the stimulus, of the mental set at the time, including mood, previous activity, etc., and in fact all observations concerning attention.

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[2] From p. 19, Guthrie, E. R., *The Psychology of Learning,* New York, Harper, 1935, by permission of the publishers.

Speaking of attention raises the question of labels for this observation that dynamic processes are not usually uniformly concentrated. This section was labeled "a core of concentration" but other labels will suggest themselves. It has been observed many times that experience has its focalized and marginal aspects. It has also been pointed out many times that a certain aspect of experience may stand out as a figure on a background. The word attention itself might have been used as a label. The chief objection to using the word "attention" is that it has been so discredited by the way the word was used to "explain" the phenomena it embraced. If we can avoid its faculty meaning it will be useful to redefine and use "attention" to refer to the coredness of behavior and experience.

The chief objection to any pair of words like "focus" and "margin," or "figure" and "ground" is that they suggest a dichotomy, a discreteness of reference. This we wish to avoid in accordance with our postulation of a psychological unity in behavior and experience.

That it is very difficult to know what constitutes the core of someone else's behavior or experience anyone would admit. But advertisers, teachers, and for that matter, all who work with people have some idea of what is claiming the attention of those with whom they work. And if this is important for the direction of learning, we must recognize the fact and seek better ways of studying attention. How it is that attention *is* of central importance in an understanding of learning, and hence for its control, will be developed in the following sections.

Continuity and Segmentation

One reason why attention is important in learning theory is that shifts of attention are the segmenting points of experience. Our first postulate might have included the observation that living behavior is not only unified but continuous. Conscious experience is also an unbroken flow except as broken by deep sleep.

The postulated unity needed to be supplemented by the observation of its coredness. Now similarly, the postulation of continuity needs modification before it becomes useful. The needed supplementation in this case is the observation of what amounts to a psychological segmentation of behavior. Behavior is marked off both as seen introspectively and for psychological purposes generally, by shifts of attention. Shifts in the nature of the core or focus segment behavior into psychological units. If the notes which compose a melody are attended to one at a time, in choppy fashion, each is a psychological unit. But if the attention is steady throughout, the whole performance is the psychological unit.

Here is a point at which it is important to have started from wholistic premises. *The psychologist who does not start from wholistic premises does not realize how variable in size the psychological unit is, i.e., how large it sometimes is. He is likely to assume that the psychological unit is the smallest one of which he can conceive. The wholistic premise, by contrast, encourages the learner and those directing learning to seek to remove the barriers to unified performance.* As pointed out earlier in the chapter, the wholistic approach favors a diagnostic approach to learning. If what we customarily think of as a sequence of responses can have a smooth continuity and psychological unity, what prevents it from happening all the time? The answer, we have postulated, is a choppy shift of attention throughout, every shift a segmenting influence.

We have now described behavior as unified, but at the same time as patterned around a core and segmented into psychological units by shifts in the nature of the core. But these postulates alone do not define learning in its essence. How do they need to be supplemented?

The Cue

Learning is profiting from experience. But what is the nature of the profit? Obviously, it is not that everything we learn is good for use. What we learn may be true or false, good or bad, valuable or worthless. What then is the truth of the expression "profiting from experience"? The answer may be inferred from the word "cue," meaning a hint. After experiencing a situation, i.e., after responding to it, some reduction of that situation can cause us to respond, as on the earlier occasion we responded to the whole situation. We are able to respond on the basis merely of a cue. This reduction of the necessary stimulation is the essence of learning.

This is a simple fact, but one of vast importance. In view of the amount of profit from his experience which has accrued to man because of it, it is one of the most significant observations ever made concerning the nature of man. The profit is a sort of biological economy. Part of the stimulating environment is said to have become a cue because not all of the stimulating situation is now necessary in evoking the response, though originally it was. The learner must have been changed by his prior experience. Hence the fourth postulate, that behavior is a resultant of influences including the engrammatic influence of prior experience. With the aid of the engram the learner is able to repeat his response with less prompting. If *all* the motivating and stimulating circumstances were alike on two occasions, the response would be the same without learning. The response would be made the second time for the same reasons it was made on the earlier occasion. It is only because the response is repeated with *less* help from the environment that engrammatic influence is indicated.

But now, pursuing our diagnostic approach, we must ask, "Why does this engrammatic influence so often fail us?" The postulated answer is that the various aspects of a stimulating situation acquire cue properties in the course of behavior only in proportion to their relation to the core of the engram produced, and that it is only through the activation of its core that an engram manifests its influence.

This postulate with those already stated describes behavior as related to learning. *Behavior is unified, but patterned as to concentration. It is continuous except as segmented by shifts in the* *core of concentration. It leaves an engram which may be reactivated by the activation of its core. Whenever a reduction is apparent in the stimulating pattern needed for a given response, learning is said to have taken place. The reduced pattern of stimulation which is then adequate to do what before it was inadequate to do is often referred to as a cue. Aspects of a situation are thought to acquire cue properties in proportion to their influence upon the core of behavior.*[3]

Learning Is Cue Production

There are many things which could be said of learning, but no characterization is more apt than that learning is cue production. One thing which is often said is that we learn what we do. The statement is made in order to emphasize the active nature of the learning process. Learning certainly comes about only from the activity of the learner. But to say that we learn what we do is to fail to refer to that which gives the word "learning" its unique meaning. One should say rather that learning takes place in the course of the learner's behavior. Or better yet, we learn *from* doing, in that after the doing we can do with less assistance.

In order to appreciate the aptness of the definition of learning in terms of its product, one must think of learning as seen with a minimum of observation. We observe that a given organism behaves in a certain characteristic way in a given situation, certain features of which are necessary to the elicitation of the behavior. We now arrange for the behavior again, this time providing a minimum of some of the necessary features and highlighting the others. Thereafter the concentrated features alone are sufficient to elicit the behavior. Learning is that which has made the reduced pattern of antecedent conditions sufficient for the elicitation of the behavior. Learning is said to have occurred because of the observed reduction in the necessary pattern of antecedents. For convenience, the reduced pattern of antecedents which is now an adequate substitute for the full pattern is called a cue. It is much less cumbersome to speak of learning as cue production than to speak of it as a reduction in the pattern of antecedents necessary for the elicitation of behavior.

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[3] This basic statement has been worded in hypothetical or conceptual neurological terms with full awareness of the arguments which have been advanced against such a practice (B. F. Skinner, *The Behavior of Organisms*, New York, Appleton-Century, 1938, p. 4 and Chap. 12). Such arguments are written by science builders for science builders. When the goal is to foster use in education, pedagogical reasons dictate an integration in conceptual terms.

Learning is often called cue *re*duction instead of cue *pro*duction. The objection to this statement is that it is only appropriate when one has in mind a connected series of learnings. In such a case, behavior first reduces the necessary stimulus situation. The resulting reduced necessary situation is cue one. Then behavior reduces cue one to produce cue two. Then further behavior reduces cue two to produce cue three, etc. The learnings in such a series may be called cue reductions.

It is true that learning is commonly identified with such a series of events. But learning should be looked for and thought about in connection with every single act of the learner. It is when learning is so considered that it is much more appropriate to call it cue *pro*duction than cue *re*duction. With neither knowledge nor assumption concerning prior learnings there is no cue to be *re*duced; there is only a cue to be *pro*duced.

It is not very satisfactory to try to describe the process of learning by reference to diagrams. The learner would have to be portrayed as supplying part of the environmental pattern because part (an important part) of this environment is within his own body. The cue-to-be (the part of the stimulating environment which is most influential in the learner's response, which in other words is most responsible for the core of the learner's response) may be an aspect of the objectively observable environment or it may be a condition or activity within the learner.

Knowing What Is Focal in Response

If you as observer or director of learning are to understand or control learning, you need to know in a given situation what stimulus feature is focally responded to. The comparative psychologist is usually fairly confident that he knows what the core nature of the animal's response is, because he heightens a drive, and so, at will, sharpens the gradient of concentration around the given drive. He also simplifies the environment and thus intensifies the influence of certain features. In his early work, Pavlov found it difficult to control learning until he had a laboratory built to enable him to eliminate distractions so that the to-be-conditioned stimulus might be focally attended to.

The teacher cannot in this manner relate the learner's activity to specific drives of known intensity. He cannot be so sure what drives are operating. Nor can he so directly observe the learner's responses; many of them are not overt. He does have the advantage, or should have it (see Part III), of knowing his learners as individuals. He knows their abilities, their interests, their scholastic habits. If he has few enough pupils to permit it, he tests the nature of the learner's thinking from time to time in order to note progress and to locate misunderstandings or other difficulties. Possibly the teacher can follow the learning process with a fair degree of success and know what has and what has not received attention by the learner. The teacher has another advantage over the comparative psychologist in addition to his better knowledge of the individual learner, and his ability to ask the learner questions. He can use introspection freely in a search for hypotheses to test. Anthropomorphism, which is considered a fault in comparative psychology, is a good working hypothesis in teaching. In short, the learning situation in education is very different from that described in comparative psychology.

The difficulty is obvious; the effectiveness of the stimulating environment cannot be described with sufficient objectivity.[4] But an appraisal must be made if learning is to be directed efficiently. It must be made because basically control over the learning process is in the nature of control over attention, either directing it in the development of meaning or holding it steady to secure continuity. The former effort is the more frequent and

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[4] Lashley, K. S., "Learning: III. Nervous Mechanisms in Learning," which is Chap. 10 in Murchison, C., ed., *A Handbook of General Experimental Psychology*, Worcester, Mass., Clark University Press, 1934, p. 487.

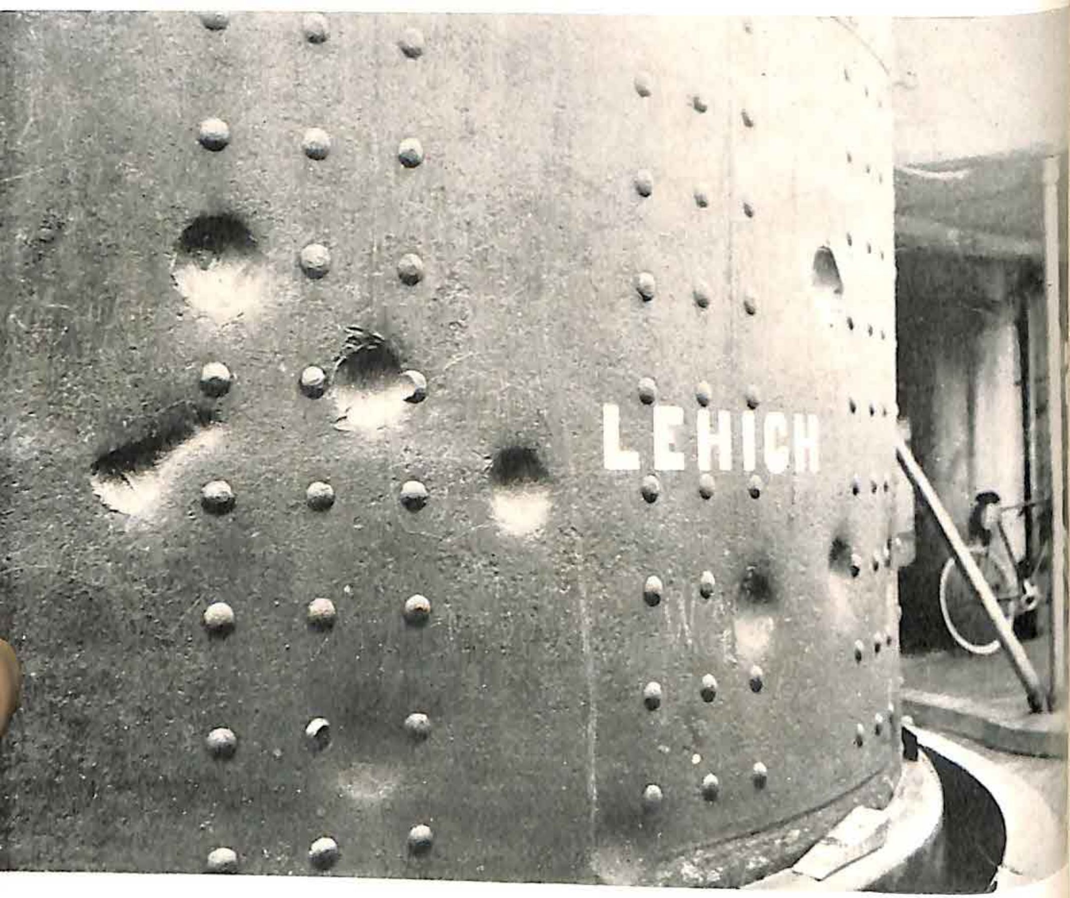

Figure 1 *C. H. Stoelting and Co.*

the more important. But not the least of the difficulties involved in the direction of learning is that of getting the learner to do or experience in the first place, what is later to be cue-initiated. The nature of these difficulties will be developed in the following chapters.

The Basic Importance of Learning

To an extent far greater than is ordinarily realized, learning has made its contribution to our most elementary experiences. The point is most easily illustrated with reference to seeing. Many of our seeing experiences are not the mere photographic representations which they are naively thought to be. For example, looking at Figure 1, one sees the many small rivet heads, and in addition some much larger indentations, most of them such as might have been made by heavy blows with a round object. Now, if the reader will invert the figure he will "see" bulges (toward him) where before he "saw" indentations. And the rivet heads will have withdrawn into the tank. The result comes with some surprise, for metal just does not behave that way.[5] The shift, as some of you realized very quickly, is due to what you have learned about light and shadow, and to having become accustomed to overhead lighting (indoors and out). But if this shift came about with some surprise, that surprise shows how unconsciously and mechanically you had included what appears to your present sophistication as an interpretation, in what we ordinarily think of as "fact."

In other words, seeing is not *mere* seeing. The visual pattern of stimulation is a cue. We respond to it now as we responded earlier to a larger pattern of stimulation of which the visual stimulation was an important part. On earlier occasions we have felt such things as rivet heads and dents while seeing them illuminated from above. Now we make that earlier full response to the cue. Similarly we notice that velvet "looks smooth," and that a bell "sounds cracked," etc. And thus does the nervous system, in what we call learning, ubiquitously but unnoticed, cumulate our experience for us. Probably all our responses to our environment, even the simplest, are somewhat in the same way apperceptive.

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[5] Occasionally an adult will not see the differences referred to. The only strange thing about these few is not in their physiology, but in the fact that they have never happened to learn what the others have learned.

Learning and Meaning

The central or basic fact of learning is also the basic fact of meaning. Learning and acquiring meaning are synonymous. This has been expressed clearly and briefly by Ogden and Richards: [6]

> The most celebrated of all caterpillars whose history is in part recorded in the late Professor Lloyd Morgan's *Habit and Instinct,* p. 41, was striped yellow and black and was seized by one of the Professor's chickens. Being offensive in taste to the chicken, he was rejected. Thenceforth the chicken refrained from seizing similar caterpillars. Why? Because the sight of such a caterpillar, a part, that is, of the whole sight-seize-taste context of the original experience, now excites the chicken in a way sufficiently like that in which the whole context did, for the seizing at least not to occur whether the tasting (in images) does or not.
>
> This simple case is typical of all interpretation, the peculiarity of interpretation being that when a context has affected us in the past, the recurrence of merely a part of the context will cause us to react in the way in which we reacted before. A sign is always a stimulus similar to some part of an original stimulus and sufficient to call up the engram formed by that stimulus.[7]

This, briefly and basically, is the psychology of meaning and a restatement of the fact of learning. For learning, i.e., the profit from experience, is being able to get, or better to *give* meaning. Learning is being able to respond to the cue alone, as before one responded to the cue in a larger setting. That an influential aspect has become a cue or a sign is another way of saying that it has acquired the potentiality of conveying a meaning. We carelessly say that the sign has meaning, but it is the learner who has the meaning (he has reactivations which are like previous experiences). If the learner has not had the background of experience we have had, then what may be a sign to us will not be to him, or at least will not be the same sign to him. Because of our background of experience we are able to add meaning to what we see, or in other words, to show the profit from our experience which we have called learning.

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[6] From pp. 52–53 of Ogden, C. K., and Richards, I. A., *The Meaning of Meaning,* 4th ed., New York, Harcourt, Brace and Company, Inc., 1936, by permission of the publishers.

[7] G. F. Stout had said this in 1899, even referring to the same "celebrated" caterpillar.

Cason, H., "The Pleasure-Pain Theory of Learning," *Psychological Review,* 1932, 39:440–466, pp. 455–456.

That this is the central fact of learning has been emphasized by Hollingworth: [8] "Signs, cues, symbols, become potent to evoke consequents appropriate to larger antecedent contexts of which the signs were partial components." And again, in different words, ". . . a partial antecedent functions appropriately or adequately for a former antecedent of greater complexity."

This concept of learning is not being presented emphatically enough as the central and unifying concept of *all* learning, whether described as association by contiguity, in Gestalt language, or as maturation, or as connection-forming, or as expectancy, or as conditioning. The differences in language used by the psychologists who describe learning have confused the picture, and prevented the student from seeing that all are referring to the same general fact. The student's attention is distracted from the underlying common core of meaning by the exaggeration of the differences of emphasis.

Not a Merely Cognitive Concept

In emphasizing the general usefulness of the concept of learning as the acquisition of meaning, it should be pointed out, of course, that the concept includes *all* kinds of behavior or response. One should not confine the concept of meaning to ideational responses. Having the different words, "thinking," "feeling," and "doing," leads us to talk about our behavior as if it were sometimes one and sometimes another of these three. It is more likely that at practically all times our behavior has all these aspects. At any rate, it is believed that what has been said about meaning is pertinent to all kinds of behavior or response whatever the combination or emphasis be; i.e., to knowledge or ideational responses, to doing responses, and to feeling responses. "C" "A" "T" *means* cat, to feel hungry *means* to eat, to hurt a child *means* to feel bad. Whether ideational, action, or feeling, meanings are involved, responding with them to cues is the basic proof or evidence of learning.

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[8] Hollingworth, H. L., *Psychology*, Appleton, 1928, pp. 5, 6.

Upon first thought one is likely to object to thinking of memorizations and skills as the doing meanings of cues. But upon consideration it will be realized that it is not inappropriate. There are some memorizations or skills which we do think of as meanings. Young children are challenged on every hand throughout the waking hours of the day to know what is expected of them. They are very much under the influence of orders to come here and go there, to do this, and not to do that. Older brothers and sisters, dominating playmates, teachers, and parents issue their instructions, all of which are learned by the child as *meaning* to "behave this way," "behave that way," "do this," "do that." Much of the meaning of language for the child is a doing meaning. Then too, there are situations in which the cues are nonverbal instructions or directions to be followed: the fire-drill signal empties the building, the bells dismiss and assemble classes, the movements of the orchestra leader regulate the performance, the players read their music. These are the results of memorization and of the acquisition of skills, but we also say: the fire drill signal *means* to *do* . . . , the bell *means* to *do* . . . , etc. In all such learning, the profit from experience lies in that before the learning, other helps than the cue were necessary to bring about the behavior which the cue alone can reactivate after the learning.

Similarly, this same process of reactivation by way of cue and core is also the process in the learning of attitudes, of appreciations, of interests, desires, purposes, motives, values, etc. When we designate the learning outcome with these words, we certainly think of the response as involving to a great extent how we feel toward the cue. Our response in such cases is largely the feeling meaning of the cue.

Kinds of Learning

It has been implied in the above section that there is only one learning process. In one sense this is thought to be the case and in another sense not the case. It is believed that all learning has the aspects emphasized in this chapter, and that understanding and control will be furthered under any and all circumstances through the use of the concepts presented.

But at the same time learning can be classified into many categories according to the outcome desired and the difficulties involved. We need to learn to recognize and to acquire meanings, to learn to understand and to learn to solve problems. We need to memorize and to acquire skills; to learn how to do, to make certain responses more consistently or less often. We need to make some responses more automatically or promptly, more efficiently or gracefully. We need to learn to want or not to want things; to learn to feel or not to feel in a certain way about people or things or situations; to learn to enjoy or to appreciate.

The direction of education is very difficult because these needs appear in all sorts of combinations. Because of their overlapping and functional integration we admit to an artifactual separation in devoting separate chapters to learning as related to outcome. But learning is at the same time both one and many, that is, it has some common and some diverse features. The present chapter has called attention to the common or universal features. They should acquire added meaning in the following chapters, as learning is differentiated.

Documentation?

Who has contributed to the general description of learning presented in this chapter? It is not an easy question to answer. Probably every aspect of the statement could be found in the existing literature. The importance attached to the coredness of behavior has its prebehavioristic roots in an emphasis upon attention.[9] It may be seen in a behavioristic setting in the emphasis upon "dominance" [10] by Lashley and by Rexroad. The continuity of experience was stressed by William James.[11] Among those who have described learning as cue production H. L. Hollingworth would certainly be mentioned. Consistently, and over a long period,[12] he has maintained that this is the essential nature of learning. And finally, even a brief documentary comment for this chapter would be incomplete without a reference to Tolman. What in this chapter has been referred to as a reactivation through cue and core, Tolman described in "sign-Gestalt" language.[13] Furthermore, he made it emphatic that the reactivation brought about by a cue is *all* that the cue means, and not a merely cognitive meaning.[14]

But except for the mention of a few close parallels, the documentation of chapters one to four must suffice.[15] The test was not and is not whether what has been written in this chapter is more like one account than another, or more like one school of thought than another. The task was to see learning in all its ramifications, but especially as we are concerned about it in education, and to describe it as fundamentally and as simply as possible.

Since the picture presented is an integration, those who have learned to think of learning as Guthrie described it are likely to see in the description a rewording of the basic concept of conditioning. Those who look at learning as Thorndike did are likely to see the chapter as a rewording of connectionism, and in particular of Thorndike's law of partial activity and of assimilation. Those who think of behavior as a dynamic process will see that behavior is described in organismic terms following the Gestalt tradition.

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[9] Pillsbury, W. B., *Attention*, New York, Macmillan, 1908, p. 130.

[10] Lashley, K. S., "An Examination of the 'Continuity Theory' as Applied to Discrimination Learning," *The Journal of General Psychology*, 1942, 26:241–265, pp. 242–243.

Rexroad, C. N., "Outline of the Conditions under Which Learning Occurs," *Psychological Review*, 1932, 39:174–183, p. 176.

[11] James, W., *Principles of Psychology*, New York, Holt, 1890, Vol. 1, pp. 237 ff.

[12] Hollingworth, H. L., *Psychology*, New York, Appleton, 1928, pp. 5–6; and *Psychology and Ethics*, New York, Ronald, 1949, pp. 95–96.

[13] Tolman, E. C., *Purposive Behavior in Animals and Men*, New York, Century, 1932, Chap. 9 and following.

[14] Tolman, E. C., "Gestalt and Sign-Gestalt," *Psychological Review*, 1933, 40:391–411.

[15] A full documentation would constitute a history of psychology. Imagine the difficulty, for instance, with regard to learning as cue production. It is clearly explicit in G. F. Stout, *Analytic Psychology*, London, Swan Sonnenshein, 1896, Vol. I, p. 263 and he identifies it with an earlier stated principle of "Diminution of Causality."

CHAPTER VI

LEARNING IN RELATION TO PROBLEM SOLVING

What Is a Problem Situation?
The Puzzling Situation
Anticipatory Response
The Not So Puzzling Problem Situation
Problem Solving and Learning Are Not Identical
Prior Learning Versus Intelligence or Insight as Explanation
Transfer
Insight
Creative Behavior
Limiting Factors
Related Controllable Factors

What Is a Problem Situation?

A problem situation is not satisfactorily defined by simply calling it a novel situation. It is generally believed that situations are not dichotomously classifiable into the familiar and the novel. It is believed that at one extreme, situations are never exactly alike, and that at the other extreme, they are never entirely novel. In other words, situations are thought of as varying in familiarity (or novelty) from the very familiar, though differing in some slight details, to the very strange, though similar in some respects. Thus, with novelty as the sole criterion, one must conclude that all situations are in varying degree problem situations. It is, we believe, a good thing to come to this conclusion, but we cannot stop there. Even though we recognize the scale from the most familiar to the most novel as a continuum, we have need, for practical purposes, to draw a separation line through that scale at some point. We want to call some situations problem situations and some not.

The best basis for making the distinction is hesitation on the part of the person facing the situation. A problem situation is one in which a response is wanted but in which a quick automatic response is not forthcoming. It might be because something wanted has been mislaid, because one wonders why a person looks familiar, because one needs or wants to know how something works, because a choice is difficult, etc. There are many occasions and many reasons for being in a problem situation.

We have now excluded those situations, in general toward the familiar end of the scale,—to which response is made promptly and without apparent hesitation. The rest are problem situations of a sort. However, they vary so in difficulty (strangeness or novelty), and in educational significance, that there is need for separate discussion, on the one hand of those problem situations toward the familiarity end of the scale, and on the other of the very strange situations. Roughly at least, we shall follow Brownell[1] and refer to the latter, the very strange situations as puzzlelike situations, and reserve for those situations of lesser difficulty the term "problem situation." We will consider first the very difficult puzzlelike situations, then situations of lesser difficulty, and then look again at the whole range as a continuum.

The Puzzling Situation

One's behavior in a very strange problem situation is commonly referred to as trial-and-error[2] behavior.[3] At this point, descriptions of animal behavior come as near to being satisfactory as substitutes for descriptions of human behavior as they ever can be, because human behavior in such situations is so animal-like or at least regressively childlike. Placed in such a very difficult situation our behavior appears to one familiar with the situation as being very ineffectual. For the adult it is an experience which teaches him what to expect from a child who is asked to solve problems which are too difficult.

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[1] National Society for the Study of Education, *41st Yearbook,* Part 2, *The Psychology of Learning,* Bloomington, Ill., Public School Publishing Co., 1942, pp. 415–416.

[2] McGeoch, J. A., *The Psychology of Human Learning,* New York, Longmans, Green, 1942, p. 28.

[3] The classic description is Thorndike, E. L., "Animal Intelligence: An Experimental Study of the Associative Processes in Animals," *Psychological Review. Monograph Supplements,* Vol. 2, No. 8, 1898.

A more recent description is Guthrie, E. R., and Horton, G. P., *Cats in a Puzzle Box,* New York, Rinehart, 1946.

For a description of the behavior of human subjects, see Ruger, H. A., "The Psychology of Efficiency: An Experimental Study of the Processes Involved in the Solution of Mechanical Puzzles and in the Acquisition of Skill in Their Manipulation," *Archives of Psychology,* New York, 1910, Vol. 2, No. 15.

On occasion, trial-and-error behavior has been referred to as blind, random, or chance behavior. If we as observers are sophisticated with respect to the problem, there does seem little sense in such behavior, as compared with the problem behavior which we consider more intelligent and efficient. But blind as the behavior may seem, the belief is that it is directed.[4] Strange as a situation may be, it will be similar in some respects to some situations faced earlier. These familiar aspects are the cues for whatever responses are made. The responses may be useful, of no use, or harmful. But whatever they are worth, they are, it is believed, all that can be brought to bear upon the situation. Perhaps one's response will be only confusion, embarrassment, anger, or other regressive (i.e., more childish) behavior. It is nonetheless what experience has taught in such situations.

The person will not necessarily recognize his response as what his experience has taught him to do. More likely he will not, because so much that is learned is learned without ever having been identified as learning (chapter five). One may respond to new situations on the basis of prior learning without being clearly aware of the nature of the cue.[5] As a consequence, if one's response is very effective and useful in a very strange situation it may come as a surprise, and leave one at a loss as to just what the nature of the solution really was. In this case, faced again, the situation is almost as much of a puzzle as it was before. Perhaps only gradually does the solution become more prompt, and better understood.

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[4] McGeoch, *op. cit.*, pp. 515–516.

[5] This seems like a contradiction of cueness as derived from being responsible for what is dominant in experience. It is not. Coredness is relative. And there is a great deal of living which is largely void of the clear awareness involved in thought, not to say of verbalization.

Anticipatory Response

This gradualness of improvement in meeting the same very difficult situation was prominent in the picture of trial-and-error behavior. It has led many psychologists to describe learning as a slow, gradual process of strengthening or of strengthening and weakening. In the five-sentence statement amplified in the previous chapter, nothing was said about this slow mastery of a difficult situation. Must that statement be supplemented in order to deal with this gradual elimination of unsuccessful responses and the correspondingly gradual increase in the promptness with which the good response is made?

Our answer is no. It is necessary only (1) to remind the reader that learning is taking place all the time in the course of the behavior in the puzzle situation; and (2) that often the new cue can cause its response to be made earlier than it was made before. For an extremely simple example, take the behavior of a fish in a tank separated into two compartments by a glass partition. Food on the other side of the glass partition causes the fish to swim against the partition and be turned away by the partition. But if the turning away can be cued to the sight of the food, it can come earlier than it did originally. The fish does not need to wait for the bump.

A response which can thus be made earlier than it could be made originally is often called an "anticipatory response." [6] It is obviously of very great value to all living organisms that learning makes it possible under certain circumstances to make an earlier response.[7] But this observation is made to call attention to the significance of certain learnings rather than as a modification of the description presented in chapter five of what is common to learning in any and all of its manifestations.

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[6] Hull, C., "Knowledge and Purpose as Habit Mechanisms," *Psychological Review*, 1930, 37:511–525.

[7] Miller, N. E., and Dollard, J., *Social Learning and Imitation*, New Haven, Conn., Yale University Press, 1941, pp. 49–53 and other pages listed in the index.

Having noted the expectation of anticipatory responses because of the influence of learning from behavior in the problem situation, we are ready to ask, "What is the response which follows an unsuccessful response?" It is to try something else. Hence among the anticipatory responses which may be expected is this turning away. But when "turning to something else" becomes cued earlier, the learner tends to turn to something else as the fish did, without the necessity of doing that from which he originally turned. Thus are the unsuccessful responses by-passed. At the same time, the successful response may be expected to be cued earlier, and it may be expected to come more promptly because of the by-passing of the unsuccessful responses. Probably it also is by-passed at times. But usually the anticipatory responses which are to be expected in connection with the successful response are not such as inhibit the successful response.

The Not So Puzzling Problem Situation

A situation which is not so strange as to be puzzling may still pose a problem. But obviously, since the situation is a more familiar one, the chances of successful response are better, as are the chances of making a successful response earlier. Also, and this contributes to these better chances, the learner is less apt to be embarrassed or confused when he finds himself in the problem situation. He recognizes the situation as not too strange and difficult and knows that the chances are not so heavily against him. Since the problem is in a generally more familiar setting the learner is more likely to have met similar problems and therefore to have a method of approach or attack. In other words, he is more likely to be systematic in his efforts.

Another difference is in the tendency to respond with thought instead of action. This is possible because in the problem situation one is on more familiar ground than in the puzzle situation. And thought is more likely in the more familiar situation because it is there that it is fostered by educational effort, both formal and informal. The ability thus to solve problems with anticipatory thought responses, and with a minimum of overt behavior, is so highly prized that for many people, problem-solving behavior is the behavior of the person who is said to have stopped to think.

Finally it should be noted that problem situations which lie toward the familiarity end of the scale are more likely to be solved with understanding. Faced again, these situations are not problems since the earlier experience cleared up the difficulty. The situation has moved along the scale and is now among those to which response is made without apparent hesitation. For some problems, so little is needed, that when in the course of the problem solver's mental trial-and-error efforts the right trial is considered, he is sure it is the solution as soon as he thinks of it.

These are the general differences but they are not intended as indicating sharp boundaries. The three regions of situations—familiar, problem, and puzzle—are not sharply set apart. How prompt and unhesitating, for instance, must a response be to take the situation out of the problem class? Suppose there is just a vestige of mental trial and error before action. Suppose response is prompt sometimes but hesitant at others. At the other end, if there are periods of confusion which pass and are followed by efficient thinking, is the situation a puzzle or a problem? Can a person's responses to a situation, no matter how strange, be all overt and devoid of mental trial and error? We think not, and though we use the term "problem" especially for situations bordering the familiar end of the scale, we admit that it is appropriate to use it throughout.

Problem Solving and Learning Are Not Identical

We are now ready to ask what the relation is between learning and problem solving. Learning, we found, is cue production. It centers around the dominant aspect of experience. Every shift in the nature of that dominance introduces a new learning. Thereafter the same behavior can be evoked by less of the stimulating pattern. The shrinkage of the pattern is around the feature most responsible for the dominant aspect or core of response. The segments of experience between shifts in this core are the psychological units of significance with reference to learning. Problem solving may be considered in relation to learning for either or both of two purposes: (1) to note how previous learning shows its influence, i.e., is demonstrated, evidenced, used, or applied, in both the successful and unsuccessful parts of problem-solving behavior; and (2) to note that within the total problem-solving sequence there are many new learnings taking place which may not be needed or used in that problem situation, but which as engrams, evokable by a cue, are stored as the profit of experience. It is therefore appropriate to say that problem solving depends upon or is the manifestation of a lot of previous learning, or to say that problem solving with its many shifts of attention is the occasion for many new learnings, or to say both. But it does not contribute to the clarification of either concept to say that learning is problem solving or that problem solving is learning.

Prior Learning versus Intelligence or Insight as Explanation

To say that whether a problem is or is not solved depends upon one's intelligence is another way of saying that it depends upon whether or not one's prior learnings are adequate for the situation. Intelligence as a noun is what you can bring to a situation from your past experience. As an adverb it is the admirable and desirable way in which you respond, with a minimum of trial-and-error behavior, and that largely mental, guided by cues which for many have no meaning. In other words, it is not a case of choosing between intelligence and prior experience as explanations of problem solving. Describing in terms of prior learning is rather an effort to give more or better meaning to the concept of intelligence. If you find you have an inclination to make a sharp distinction between the use of what you have learned on the one hand, and intelligence on the other, consider whether it is not due to a belief that situations are of two distinct kinds, repetitive and novel, and that learning provides for your behavior in one, but that intelligence must provide for it in the other.[8]

It must be remembered that the picture presented in this and the previous chapters rests rather upon the assumption of no exact repetition and no total novelty. Also, it must be remembered that learning has been described as of such a nature that it can be manifest only in a somewhat novel situation. Learning is proved to have taken place when there is response to a cue. The word "cue" as used here means that less of the previous environment is involved. In other words, that learning has taken place in the course of a given experience can be proved only in a somewhat different situation. Thus does the learning of yesterday help explain today's behavior in a problem situation, and thus do problem situations test yesterday's learning.

Transfer

It should be obvious by now that a theory of transfer has already been stated in this chapter, was in fact stated in the previous chapter. Transfer is evidence of profit in situation B which is attributable to learning in a somewhat different prior situation A. If anyone considers it an open question whether there is transfer or not, the answer offered is most emphatic. Learning being what it is, transfer is demonstrated whenever learning is proved to have taken place.

Most of the confusion concerning transfer [9] arises from the identification of transfer as a fact, which psychologists have never questioned, with a certain theory of transfer, known as formal discipline. Before it was realized how intelligence is gradually acquired as a result of experience and summoned to our assistance by mere cues, a hypothetical agent (faculty) was supposed to provide responses to novel situations. The thinking was, in a way, a reification of function, like having a god of rain and a god of sunshine. The most serious disadvantage in such reification, as far as transfer is concerned, was that it led people to expect too much of transfer, as is shown by the data which have been accumulated during the last fifty years. Formal discipline as a theory of transfer has been discredited. Transfer as a fact has not been questioned. The explanation of transfer, we submit, is and must be an integral part of a theory of learning. The first test of a theory of learning should be its adequacy to embrace and unify the facts of problem solving, intelligence and transfer.

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[8] An example in the literature is Orata, P. T., *The Theory of Identical Elements*, Columbus, Ohio, Ohio State University Press, 1928, pp. 175–176.

[9] Kandel, I. L., "Transfer of Training Again," *School and Society*, Sept. 24, 1949, 70:202.

Insight

The term "insight" is used to refer to the recognition of an anticipatory response as being the solution before the overt solution response is made. It is not worth much as an explanatory concept. To say that a problem is solved because of insight is like saying that one succeeds in finding a lost object because of the joyous recognition of the object when it is found.

The trend in psychology has been either not to use the word, or to redefine it. As emphasized in Gestalt psychology, insight is not confined to the occasional outstanding experience to which most people are referring when they use the word. As revised, insight pertains to all behavior. No matter how stupid the child's or animal's response may seem to the sophisticated adult, there is a sense in which, *at its level of maturity,* the response is appropriate to the occasion, always insightful and meaningful.

In affirming, earlier in the chapter, that all responses are such as experience provides, whether good, bad, or indifferent as seen by an observer, we have similarly denied the dichotomy which is implied in the common meaning of the word "insight." Having done so, it seems appropriate to us to continue to use the word "insight" in referring to those outstandingly pleasant experiences in problem solving to which the term is customarily applied. We wish to refer to such experiences. It is out of such moments that the most certain learnings come. It is after insightful solution that problem situations are more likely to cease to be problems when faced again. We have postulated that learning is in proportion to the steepness of the gradient of concentration. Insightful solutions are usually moments of maximum concentration. They are more likely to occur in problem than in puzzle situations. Problem solving thus yields not only many but certain learnings, not to mention the greater likelihood of their use because related to pupil interest.

Creative Behavior

But, it may be objected, the above picture of problem-solving behavior is too dependent upon past experience. Is there not something creative about problem solving? There certainly is. To point out how behavior is related to prior learnings is not to say all that needs to be said about behavior. Learning is important but it is not all. As observed in the previous chapter in statement number four, and as was emphasized by Lewin, behavior is a resultant of *all* the forces operating *at the moment.* That behavior is engrammatically influenced is only one part of the picture. If the situations we face have emergent qualities, then there is an emergent quality about the pattern of behavior. Whatever we have for the present situation, prior experience provides, but if the situation is emergent in quality, behavior also may be expected to be creative. Whenever a new conjunction of cues operates, behavior has its creative aspects. That happens, we believe, to a slight extent all the time, and to an observable extent more frequently than is realized. What is more creative than the use of the words one has learned to describe his experiences? Reading is creative thinking. Out of the learnings of prior experience the reader supplies the meanings for the word cues which the author has provided in a new pattern. Reasoning is creative.

A tendency to use the word "creative" for only the strikingly creative acts of a relatively few people in only a few areas of living (music, the fine arts, and invention) keeps us from recognizing it everywhere in its lesser degrees. It is also necessary for clear thinking in this connection that we be aware of a double reference. It is one thing to call an act creative because of the value attached to it by audience, critic, instructor, employer, or judge; it is another to call a person's behavior creative because for that person the behavior is to some extent new or original. It is in this latter sense that we conclude that we live creatively, constantly thinking, acting, and feeling in what are for us patterns which are at least slightly original.

Limiting Factors

It must not be supposed, because intelligent and creative living have been described as depending upon prior experience, that there is no limit to what education can do. As will be shown in chapter twelve I.Q. differences are a closer reflection of factors at present outside our control than of such environmental factors as seem controllable.

One can only guess at the anatomical or physiological differences which may be involved. It may be that there are individual differences in the extent to which experience leaves its traces in the nervous system. There may be differences in the integrity of the traces. There may be differences in the extent to which neural behavior is cored.

In other words, some brains may always perform more at a common level of intensity, others may be more characterized by gradients of intensity. There may be differences in the ease with which engrams, activated at the core, are reactivated in their entirety. These are mere conjectures: questions for the anatomist and physiologist, prompted by the observable facts concerning learning and problem solving.

Related Controllable Factors

There are, however, steps which can be taken in the interest of better learning for problem solving and better use of what is learned. Since Meredith[10] and Woodrow[11] turned experimental attention away from the question of "How much transfer?" and toward the question, "How get more?" there has been no doubt but that planning and effort are in order. When students are aware that transfer is expected, and when teachers try to prepare for it, the results are better.[12] It would be strange if it were not so.

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[10] Meredith, G. P., "Consciousness of Method as a Means of Transfer of Training," *The Forum of Education*, 1927, 5:37–45.

[11] Woodrow, H., "The Effect of the Type of Training upon Transference," *Journal of Educational Psychology*, 1927, 18:159–172.

One thing teachers are doing is taking more care and time to develop concepts, generalizations, and principles from a variety of concrete meaningful experiences. The likelihood that such cues will be recognized or identified in a problem situation depends upon the extent to which they are taught by abstracting them from a well-chosen variety of situations similar to those in which application is expected. When faith is placed in formal discipline the need for such an emphasis is not apparent. The individual differences referred to in the above section are very important at this point. Terman, in contributing to a symposium on *Intelligence and Its Measurement,* wrote in italics that "an individual is intelligent in proportion as he is able to carry on abstract thinking." [13] Now that it is realized that intelligence has two meanings, one referring to native limitations, and the other to acquired ability, Terman's observation also means two things. As everyone knows it means that teaching effort cannot make all students equally able to deal with abstract ideas. But it also means, what we know and ignore, that the success that *can* be achieved by the less able must come more slowly and patiently from more concrete meaningful experiences. The development of children of even average ability sometimes suffers when they are rushed along with the group.[14] Too much is taken for granted. There is a lot of teaching which proceeds as if faith could be placed in formal discipline. The only intelligence upon which education can afford to depend is the intelligence for the development of which it meticulously provides.

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[12] Kingsley, H. L., *The Nature and Conditions of Learning,* New York, Prentice-Hall, 1946, Chap. 19.
Stroud, J. B., *Psychology in Education,* New York, Longmans, Green, 1946, Chap. 15.

[13] *Journal of Educational Psychology,* 1921, 12:128.

[14] See Fernald, Grace, *Remedial Techniques in Basic School Subjects,* New York, McGraw-Hill, 1943, pp. 218–219, 245–246, for a description of the lack of experiential meaning of a thirteen-year-old boy with an I.Q. of 105. See also Tilton, J. W., "Individualized and Meaningful Instruction in Arithmetic," *Journal of Educational Psychology,* 1947, 38:83–88.

But having had the prior experiences without which a problem

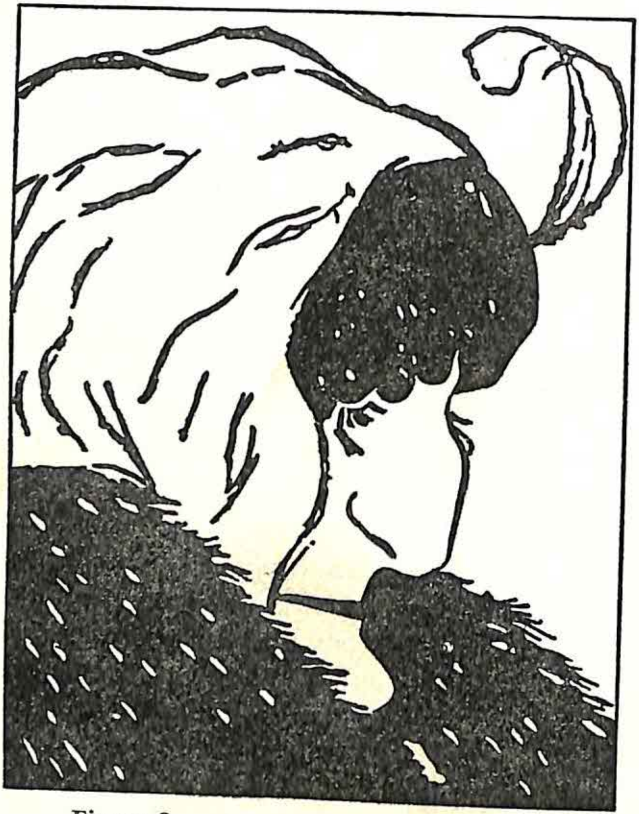

Figure 2

cannot be solved is not a guarantee that it will be solved. Unless the problem is a very easy one, much depends upon an exploration of the situation. It needs to be seen (mentally if not literally) from many angles. This, in the language of chapter five, is giving the various aspects of the situation their turn to act as cues. What engrammatic interpretation is made depends upon what aspect of the situation is the center of attention. Take Figure 2 for example. If you focus at a low central point you see in profile an old lady with a very straight-lined mouth and with a prominent nose and chin. Let your eye move up and to the right and you see a young lady, also in profile, whose chin was the old lady's nose. A prominent eyelash shows, but very little of her nose.

Some people, having seen one of these ladies, have great difficulty seeing the other at will. This also may be used to illustrate a point. People seem to vary a great deal as to their open-mindedness in a problem situation. Some aspect assumes an influential role, and the person is then handicapped as far as exploration is concerned. They make what might be called a one-meaning response to situations. It is not conducive to problem solving nor to creative response. There is need to cultivate a habit of exploration, a need to ask of a new situation not, "What does it mean?" but, "What are its meanings?" Many valuable discoveries have been made by people with inquiring minds seeing in situations things they were not looking for.[15] Perhaps a strong feeling of need or urgency interferes with such a fertile attitude.

The reader must not get the impression that efficiency of exploration is an all-or-none matter. A student may be very efficient in his attack upon originals in geometry and unimaginative in his consideration of a problem situation in history. Problem-solving attitudes may be expected to generalize only to the extent that student and teacher have taken steps to bring generalization about.

One thing is sure, a pupil is not in a position to use or apply what he knows to a problem situation if he has learned to respond to problems with fear, or dread, or embarrassment. Such feelings are themselves likely to be central or core aspects of experience. The cues which need to exercise their influence have little chance against such powerful competition. It is the very difficult but challenging task of education to see that a large enough proportion of the problems a pupil is asked to solve are suited in difficulty to his preparation. Wheeler and Perkins called this educational need the need for "pacing." [16] Improvement in this direction alone should in the long run be very profitable.

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[15] Cannon, W. B., "The Role of Chance in Discovery," *The Scientific Monthly*, March, 1940, 50:204–209.

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[16] Wheeler, R. H., and Perkins, F. T., *Principles of Mental Development,* New York, Crowell, 1932, p. 197, also see index.

CHAPTER VII

LEARNING AS RELATED TO PRACTICE

Introductory Review
Automatization
Cue Variety
Memorization
A Hierarchy of Learnings
Imitation
Direction of Attention
Practicing an Error
Timing
Good Form
Multiple Learnings
"Practice Makes Perfect"?
Limiting Factors
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Introductory Review

In chapter five the following working hypotheses were stated. Learning is the psychological profit which accrues from experience. The amount of profit from an experience is in proportion (1) to the novelty for the learner of the pattern of response and (2) to the extent to which the experience is cored around a high point of attention. The profit derives from the nature of the nervous system in that to activate the core is to reactivate the whole engram of which it is the core. The original response may thus be evoked by any situation which can activate the core. Some reduction of the original stimulating situation will suffice, provided it includes the features which were most influential in the learning experience. When after an experience has produced its engram, a reduced stimulating environment brings about a response which before could be evoked only with the aid of the full stimulating environment, the reduced situation which has acquired this potency is called a cue.

With this concept of learning, it was pointed out in chapter six, it is quite unnecessary to reify a factor with which to explain problem solving. So conceived, learning provides for novel situations if, as is believed, situations are never wholly novel. So described, learning is a remarkably effective integrating concept. Meaning, perception, interpretation, understanding, application, intelligence and transfer run together inextricably as manifestations of prior learning. There is no doubt but that the concept of learning advanced is useful for education in its concern for the development of intelligence.

But what about the routine aspects of living? What about memorizing, the development of skills, and the formation of habits? Important as it is to develop problem-solving ability, no one would want to neglect the great host of facts and skills which need to be dependably mechanized for efficient use. There are many important objectives which are achieved only in the course of practice and more practice. We must therefore ask at this time "What is the bearing upon this great need for practice, of the concept of learning set forth in chapter five?" This is the question for the present chapter. We begin by asking why and under what circumstances practice is needed.

Automatization

In a way, all of this chapter is devoted to a consideration of the automatization of behavior. But there is a more precise meaning for the word "automatization" which it is advisable to develop at the outset. In pointing out, in the following sections of the chapter, that many of the different needs for practice are due to inefficient learning conditions, the extreme position will not be taken that there is no necessary gradualness about learning. The account offered in chapter five emphasized what is too commonly ignored, that in a sense learning is a function of a single act. It was not denied in chapter five and must be admitted in this chapter that on occasion learning may be appropriately described as gradual. This is especially true when a long-term objective has been defined. Furthermore, cue production has its quantitative aspect as well as the qualitative one in terms of which we are apt to think, in considering problem solving. The reduction of the necessary stimulus pattern which constitutes learning may in its early stages impress the observer as being largely qualitative and in its late stages as being largely quantitative. The former we think of as rapid because striking or spectacular, the latter, as slow and gradual because the reduction of the needed stimulation is less obvious. In the latter case, learning automatizes behavior in that, after many experiences, a mere vestige of the originally needed stimulating situation is sufficient to cue the original response. This sort of learning is wanted and needed in many phases of routine. These gradually produced vestigial cues are needed so that functioning may be depended upon in the face of all sorts of competing distractions.

Cue Variety

But automatization is not the only guarantor of dependable performance. In some situations, an important safeguard is to have the required response cued to not just one feature of the situation but to many. Then if one cue is not noticed another will serve. Suppose, for example, that one is learning a route. If each decision is cued to a variety of landmarks, the chances of errorless performance are enhanced. Failure to have noticed one landmark will be of no consequence if another serves.

A great deal of the stabilization of performance is of this nature.[1] It can come about only through "practice" but will come more slowly than need be if neither the learner nor instructor is seeking this outcome.

Memorization

Sometimes the learning task is to remember a series of facts in a given order or to do certain things in a given order. If the part responses are already automatized, it is uncanny, at times, with what ease and rapidity the parts fall into a unified pattern. Notes suddenly become a melody.

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[1] Guthrie, E. R., *The Psychology of Learning*, New York, Harper, 1935.

Now if a succession of events can suddenly become an integrated sequence, why does it not always do so? What are the circumstances favorable to its happening? In chapter five, of the five basic postulates about behavior offered to describe learning, the third hypothesis was advanced to account for segmentation. According to this hypothesis when continuity is not achieved it is because it is prevented by shifts in attention. A person who wants a series to become an integrated sequence which will flow from beginning to end without prompting will effectively prevent such an outcome by meticulously and intently fixing attention, staccatolike, upon the several steps. Contrariwise, he will succeed to the extent that he can fix his attention upon a steady or overlapping feature of the series. The beckoning hands of the parent are the best help the parent can give to the child ready to learn to walk.[2]

If the whole task is so large that the learner's attention cannot be held steady throughout, it will have to be subdivided.[3] Having subdivided the task as much as is found to be necessary, the learner will profit by performing in a speedy and rhythmical fashion.[4]

A lot of practice in the effort to memorize appears to be wasted because no effort is made to direct attention upon the whole qualities of the performance. In other words no effort is made to eliminate the attention habits which prevent the desired learning. It cannot be said with any certainty that the amount of practice

[2] Woodruff, A. D., *The Psychology of Teaching*, New York, Longmans, Green, 1946, p. 62.

[3] The recommended procedure has been referred to by experimenters as the "combination method," a combination of the whole and part methods.
Kingsley, H. L., *The Nature and Conditions of Learning*, New York, Prentice-Hall, 1946, pp. 228–229.
Peterson, H. A., Marzolf, S. S., and Bayley, Nancy, *Educational Psychology*, New York, Macmillan, 1948, Chap. 10.

[4] Ogden and Freeman speak of skill as a "melody of movement."
Ogden, R. M., and Freeman, F. S., *Psychology and Education*, New York, Harcourt, Brace, 1932, p. 261.

currently given to memorizing could be materially reduced, but it is believed that it could be. To keep our question for this chapter in mind, it seems that in part, practice is needed in such tasks because of the difficulty of getting attention away from details and of holding it upon a steady feature of the task.

There is support for this view, not only in the scattered testimony of efficient memorizers, but in the fact that attention to details is disorganizing after the integration is achieved.[5] Attention to phases of the swing in golf, to the steps in dancing, to notes in singing, or to the steps in running upstairs have a tendency to disrupt the smooth continuity of performance.

For the present, the reader is advised to proceed upon the hypothesis that two reasons why so much practice seems necessary in memorizing are: first, poor understanding of the part played by attention, and second, difficulty in holding attention steady enough to allow the desired integration. Even if the learning in memorizing, which on the surface appears to be a sort of temporal reduction in the need for prompting, is reducible to the recueing of all responses to a single steady core, this advice is still a good working hypothesis.

A Hierarchy of Learnings

Very often, such coalescing of responses into a larger pattern must wait upon a familiarity with, and command of the parts. For them to lose their psychological independence efficiently they need to be past claiming attention. There should be nothing strange about them as situations and nothing effortful about them as responses.

This needs saying, lest we go to unrealistic extremes in advocating a wholistic method. A task does need to be seen in its practical setting. It does need to be understood as well as possible as a whole from the beginning. Also it needs to be practiced as a whole as soon as feasible. But preparatory work and, from time to time, corrective work with details will be necessary. There

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[5] Guthrie, *op. cit.*, p. 146.

is no point in emphasizing speed[6] and rhythm and a nonsegmenting attention in the interest of smooth organization, until the performances which are to merge can be commanded with marginal attention.

Imitation

If the imitator has both a good perception of the model (correct and wholistic) and a good preparation for doing all that is involved, performance may be excellent with very little practice. This is a case of creative problem solving, the model serving as a new pattern of cues for the imitator.

The practice required in trying to imitate is needed largely because of (1) having a poor idea of the performance, (2) not having the needed control over some aspect of it, or (3) copying atomistically and thus preventing unification of performance. The learner is not always aware of the imperfections referred to in (1). He may continue to do what, in his blissful ignorance, he considers to be a duplicate of the model. But if he has the reaction of a critical audience or instructor, or if the performance is objectively testable by its effects, then there is need for a great deal of comparison. "What am I doing that you did not do?" or "What did you do that I am not doing?" or "In what respects is my performance unlike yours?" It is out of such a concern to examine by comparison that attention is directed to features not before noticed. And this calls our attention to one of the most important topics in the psychology of learning.

Direction of Attention

The direction of attention looms as large in any discussion of the implications of the psychology of learning for teaching as it did in the previous chapter as a factor in the use in problem solving of what has been learned. The direction of attention is an important part of teaching.[7] The pointer, literally and figuratively, may be said to be the teacher's tool.

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[6] Taylor, D. W., "The Learning of Radiotelegraphic Code," *American Journal of Psychology*, 1943, 56:319–353. See pp. 327–331.

It is at times extremely difficult to direct attention. The teacher points if he can. He can point to illegibilities in writing, to spelling errors, to incorrect computational procedures, to poor stance, to faulty handling of tools, etc. The instructor may put the learner through the desired motions to call attention to certain aspects of the performance, but this is a poor substitute for feeling what it is like to do the required task on one's own initiative.

Imagine the difficulty which Miss Sullivan faced in trying to teach Helen Keller the meaning of her first kinesthetic "words" without the help of an understood language which is available in teaching a hearing child. Miss Keller has described these early efforts.[8] Progress had been extremely slow until with a happy combination of the circumstances Miss Sullivan presented the stimuli which were to mean water just as cold water was pumped over the child's hands. For the first time conditions were right; the learning was prompt and thrilling. This experience taught more than the meaning of the sign for water. It taught the meaning of Miss Sullivan's efforts. From then on the "vocabulary" grew fast. Miss Keller reports that she sought immediately the "names" of many things. Before that experience, we may assume, learning did not come about because the things uppermost in Miss Keller's mind were awareness of Miss Sullivan's efforts, awareness that she (Miss Keller) was not doing what was expected of her, a feeling of frustration, and many other things than those which needed to be uppermost in order to bring about the desired learning.

A great deal of practice by more mature learners is of a trial and error sort, trying it this way and that way, and trying to remember what it felt like when one of the trials turns out to have been good performance. Each phase of an exploratory examination of the model and each exploratory performance helps to draw attention to similarities and differences and thus to isolate the needed knowledge and control.[9]

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[7] Miller, N. E., and Dollard, J., *Social Learning and Imitation*, New Haven, Conn., Yale University Press, 1941, pp. 211–212.

[8] Ross, Ishbel, "The Extraordinary Story of Helen Keller," *Readers Digest*, July, 1950, pp. 161–168. See p. 165.

Our observations lead us to believe that whatever the age of the learner, the efficiency of learning is gauged by the concentration of attention. When attention drops from boredom or fatigue, practice would better stop, unless the objective is automatization. If learnings in their earlier stages are involved, progress may be expected only under conditions of clear attention. Distributed rather than massed practice is then indicated.[10] Taylor [11] reported as much progress by his subjects practicing one hour a day as was made by another group practicing four.

Much may be done to control the situation but it may be expensive. Pavlov in a laboratory situation directed attention by having a laboratory built in which distractions could be prevented. A riding instructor [12] had a twenty-seven foot scaffolding built so that he could prepare the needed overhead views of good riding form. Slow motion pictures, recordings, and demonstrations can be very useful. Repeated use of these aids is desirable. The learner cannot, except by chance, see all in a demonstration which he needs to see. What he gets will depend upon the part upon which his attention is centered. Photographic records of the eye movements involved in looking at pictures [13] make it clear as did Figure 2 that what is seen varies a great deal with the focus of attention.

An efficient demonstration for a particular difficulty should highlight that feature. In one sense the poorest demonstration ever staged is the performance of the efficient sleight-of-hand artist. He directs attention anywhere but upon the feature which the audience would like to see.

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[9] Dutton, E., "An Experimental Investigation of Association and Dissociation in Learning," *Journal of Educational Psychology*, 1948, 39:1–18.

[10] Kingsley, *op. cit.*, pp. 246–250.

[11] Taylor, *op. cit.*, pp. 334–335.

[12] Lewis, B., *Riding*, Garden City, N.Y., Garden City Publishing Co., 1939, pp. 140–141.

[13] Brandt, H. F., *The Psychology of Seeing*, New York, Philosophical Library, 1945. Buswell, G. T., *How People Look at Pictures: A Study of the Psychology of Perception in Art*, Chicago, University of Chicago Press, 1936.

Sometimes the difficulty which is involved is not so much a difficulty in directing attention as it is not knowing what the trouble is. In other words sometimes the direction of attention for efficient learning has to be based upon a diagnostic study of individual pupil performance.[14] Fernald[15] quickly remedied a case of mirror writing by cueing performance to the appropriate side of the paper or blackboard. Much practice would have been wasted in this case but for this simple yet extremely efficient direction.

Practicing an Error

One of the most interesting functions which practice may serve in learning is to deautomatize an error. Those who had accepted "use," "exercise," or "practice" as a basic principle of learning with little thought as to the nature of its functioning were shocked when Dunlap, on the basis of supporting data, suggested practicing an error in order to eliminate it.[16] Part of the difficulty which his readers felt in accepting his facts came from lack of careful reading. Dunlap's suggestion was not a blanket suggestion to practice behavior in order to eliminate it. The habits for which he recommended negative practice were like those of the experienced typist who finds that he has developed the habit of writing "hte" for "the."

For a fault, in any well-mechanized behavior, for instance, such as in writing or speech, practicing the error may be profitable. The performance to be corrected needs to become again an attentive process. It needs to be deautomatized. Practicing the writing of "hte" deliberately accomplishes this end.

It is important to remember that in all the cases in which such negative practice is appropriate, the learner has the fully developed ability to perform correctly if only he can again be aware or attentive every time he comes to the error. All the writer of "hte" needs is to be aware of the "the's" whenever they occur, so that the performance will be consciously taken care of. As Dunlap phrased it, "The essential point is to bring under voluntary control the behavior pattern which has been involuntary." [17] Then gradually the correct performance can be automatized again.

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[14] Tilton, J. W., "Individualized and Meaningful Instruction in Arithmetic," *Journal of Educational Psychology*, 1947, 38:83–88.

[15] Fernald, Grace M., *Remedial Techniques in Basic School Subjects*, New York, McGraw-Hill, 1943, pp. 91–92.

[16] Dunlap, K., "The Technique of Negative Practice," *American Journal of Psychology*, 1942, 55:270–273.

Timing

A list of the reasons for practicing would not be complete which omitted mention of the fact that sometimes timing, though an important condition for the needed learning, is uncontrolled. When that is the case, learning waits until, among the many performances, timing happens to be favorable.

A good illustration of the need for timing was provided by an experience "of a certain psychologist" which Guthrie relates.[18] In opening the door of a strange garage a chain hanging on the inside of the door swung around and struck him. This annoying reception had to be experienced on several occasions before anything outside the door served to remind him in time of what was to be expected. Had the chain been visible from the outside, avoidance would have been cued promptly to the sight of the chain. There is a lot of wasted effort to change habits which fails from poor timing. Admonitions, scoldings, and punishments are often wasteful for the same reason. Remarks to a member of one household made no impression upon a habit of not closing a spigot. But a reminder tied to the spigot soon changed the habit. Teachers and parents would do well to ask, "Am I providing a cue when it is needed?"

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[17] Dunlap, *loc. cit.*, p. 270.

[18] Guthrie, *op. cit.*, pp. 158–159.

Good Form

One of the most important functions of practice is to provide opportunity for the refinement and improvement of performance. Usually, in learning any complex skill a point comes at which the need is to eliminate certain useless features which characterize the performance of the beginner.[19] This is effected in part by the gradual process referred to in the previous chapter as "by-passing." There is nothing inherently selective about the anticipatory by-passing of intermediate steps. Useful and necessary steps would drop out for the same reason if consequences did not prevent. For instance, in the shifting of gears by the driver of an automobile, if anticipatory by-passing results in a curtailment of foot action, the consequences are immediately apparent and supply the needed corrective influence.

In part, the features which drop out of the achievement of good form do so because they were caused by feelings of strain and self-consciousness. These feelings give way to self-assurance as the learner and his critics find less and less difference between his and "skilled" performance.

Multiple Learnings

Finally, and by no means least, of the situations in which practice is necessary, there is the need to learn many things at the same time: numbers, words, names, definitions, facts, symbols, etc. No great difficulty would be involved in learning any one of these things. The difficulty comes from the confusing multiplicity of the task. If a new pupil is transferred to a teacher's class late in the year, to see and hear his name is to learn it. But to learn the names of one hundred seventy-five strange pupils in the fall, or even of thirty-five pupils, requires practice.

Dress these strange pupils in uniform and the task is still more difficult. The less individuality or uniqueness they have for the teacher, the more difficult and confusing the task.[20] If the name-learning task could wait until each pupil had become for the teacher a unique person, in other words, until the teacher knew each of the pupils well, the name-learning task would be much simpler.

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[19] Kingsley, *op. cit.*, pp. 216–217.

In similar fashion, a lot of the difficulty of any multiple-learning task is due to the confusing lack of unique character of the things involved. The learner must familiarize himself with a lot of strange things in order to learn about them the thing that is required, and do it all at once.

In such a situation some inefficiency of learning is inevitable. A great deal of data has been reported, referred to in the psychological literature under the heading of "retroactive inhibition," [21] which shows that the part of the task practiced first interferes with progress on the part to which effort is next directed. This learning in turn interferes with the retention of what is already learned.

These "retroactive inhibition" and "serial position" data, and all such multiple-learning situations clearly illustrate that responding to cues because of prior learnings, defined in this book as a psychological profiting from experience, can be unprofitable under certain circumstances, viewed as education.[22] The less familiar the learner is with the materials with which he is working, the more likely it is that negative transfers will occur. However, negative transfers are not entirely negative in their educational value. Mistakes may be good teachers. Informed of the incorrectness of response, the learner's attention may be called to differences he hadn't noticed, and he may be motivated to get better acquainted with the confusing materials as quickly as possible. The difficulty faced makes a great demand for the exploratory examination emphasized under the topic "The Direction of Attention."

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[20] Gulliksen, H., and Wolfle, D. L., "A Theory of Learning and Transfer," *Psychometrika*, 1938, 3:129–149, 225–251.

Gibson, E. J., "Intro-list Generalization as a Factor in Verbal Learning," *Journal of Experimental Psychology*, 1942, 30:185–200.

Plotkin, L., "Stimulus Generalization in Morse Code Learning," *Archives of Psychology*, 1943, Vol. 40, No. 287.

[21] McGeoch, J. A., *The Psychology of Human Learning*, New York, Longmans, Green, 1942, Chap. 11.

Hilgard, E. R., *Theories of Learning*, New York, Appleton-Century-Crofts, 1948, pp. 161–170.

[22] This unprofitable profit is often called "negative transfer."

"Practice Makes Perfect"?

The above examination of the part played by practice has shown that the role is a varied one. Practice was found to be necessary for the continued reduction of the essential stimulus which is so very important if a way of behavior is to be depended upon in spite of distractions and other claims upon attention. Practice is also necessary in order to cue such responses to a variety of the features of the situations in which the response needs to be guaranteed. Practice provides an opportunity for any necessary preparatory learning involving parts of complex tasks, an opportunity for getting a better idea of the goal, and, in the later stages of learning a skill, an opportunity for the by-passed elimination of useless features. Practice may be useful in deautomatizing a response when it needs to be performed with attention to correctness. In the course of practice, chance may provide for the steady attention needed for psychological continuity, may direct attention to a feature which the learner needs to notice, and may provide some opportunities for learning under favorable timing conditions.

What shall one say then, of the expression "practice makes perfect"? The answer is that practice may or may not help. The value of practice depends upon the extent to which the needs of the learner at his present stage of learning are met during the practice. A bad feature about a blanket prescription of practice is that it may automatize error. Probably a great deal of practice is better evaluated as wasteful than as good or bad.

Every instructor or learner, when he finds himself depending upon practice, should stop and ask, "Why is practice needed?" and, "Is the planned practice well designed to supply that need?" Learning does have a slow aspect, but in more respects it is rapid. Those who are not aware of this fact, who think that learning is always and inevitably a slow process, are not likely to discover ways of directing learning more efficiently.

Limiting Factors

But no matter how efficiently individual needs are diagnosed and provided for, individual structural differences will impose limits upon progress toward the goals for which people practice. It is mere speculation whether the same kind of neural anatomy and physiology is involved in learning abstract ideas, remembering directions, and learning to type. It may be that a brain which is good for memorizing or automatizing is not necessarily sensitive to the similarities and differences which are so important in the isolation of abstract ideas. If this should prove to be the case, then the qualitative, quantitative, and temporal dimensions of learning which have become apparent in this chapter will need to receive emphases as kinds of learning. We have chosen rather to emphasize the common character of all learning. There are differences in the way the cue compares with the stimulus situation for which it can substitute, but it is always a reduction of it.

It does not seem necessary to postulate an independent basis in neural structure for automatization, memorization, and abstraction. The low correlation between these abilities is easily understandable on other bases. In the first place, attentive exploratory habits are very important for the isolation of abstract ideas. If a person has not developed those habits, we lack good evidence of the extent to which he is structurally well provided for intellectual development. In the second place, assuming a single neural aptitude for all learning, a person poorly provided could compensate in memorizing to a marked degree with a good development of the attitude and attention habits favorable to memorization. And in the third place, such a person could and does compensate in automatization with the aid of practice.

Whatever the facts are concerning the structure of the nervous system, it is clear that other structural differences are important limiting factors. This is apparent to the extent to which it is appropriate to call the outcome of practice a motor skill. One body build is good for the high jump and pole vault, another for distance running, another for swimming, and another for wrestling. Factors like reaction time, quick availability of energy, quick recovery from fatigue are important in sport. Factors like sensory acuity or the structure of the vocal cords set important limits in the development of vocal ability. And in addition to the facts with regard to structure there are deep-seated attitude and habit differences of which an instructor needs to be aware. Learners are unequally resourceful. Some can be depended upon to make much progress from their own efforts, others are more dependent upon the instructor and a model. One will prefer to read the directions, another to be told, and another to be shown. Teaching which is not designed to fit individual needs cannot be expected to result in the most efficient learning.

Forgetting

A limiting factor which deserves special consideration is the toll taken by forgetting. Its influence has been referred to already in this chapter under the subtopic "Multiple Learnings." For, it is now thought, forgetting is the negative influence of subsequent activities upon the results of learning and not a mere fading out from disuse.[23] Ever since Jenkins and Dallenbach[24] published their data indicating that "forgetting is not so much a matter of the decay of old impressions and associations as it is a matter of the interference, inhibition, or obliteration of the old by the new," there has been a gradually increasing tendency to look beneath the concepts of "use" and "disuse" for their significance.[25] Oddly enough the results of learning are protected by disuse and may be lost in the course of the relearnings which come with use. This revision of thought with regard to forgetting is, in fact, one of the most influential of the factors which are gradually modifying the traditional uncritical emphasis upon practice.

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[23] McGeoch, *op. cit.*, Chap. 11, "Fundamental Conditions of Forgetting."

[24] Jenkins, J. G., and Dallenbach, K. M., "Oblivescence during Sleep and Waking," *American Journal of Psychology*, 1924, 35:605–612.

[25] Hilgard, *op. cit.* See index references, p. 400.

Things have to be "overlearned" [26] if they are to withstand the inroads of other activities and the revised learnings which they bring. If it is desired that responses to cues persist, they need to be learned not only for immediate use when the conditions are most favorable, but cued to a variety of situational features and automatized. The materials or situation must have been thoroughly explored to the point of familiarity. Probably the things best remembered are the things which have been thus most "overlearned."

Even if these steps are taken to make the results of learning permanent, the cues which once sufficed may still fail to do so under markedly different circumstances. More than we are likely to realize, the general setting is part of the cue. A teacher may know a pupil's name well enough to use it in school, but fail to remember it on the street. Or years later, the pupil may be remembered as a former pupil whose name cannot be recalled. Even responses which were quite "overlearned" years ago may fail one in a setting far removed in every way from the learning situation. This may be said with some confidence because the re-creation of some of the original situation is known to have been of sufficient help to make the long unused responses function again.[27] Everyone, it would seem, must be somewhat aware of this phenomenon, for the first effort one makes when he cannot remember where he placed something is to try to recapture some of the situation when he last used the article.

In brief, then, to be as sure as possible that what is learned may be depended upon to function when needed:

1. Provide for a variety of cues so that if one cue is not adequate, another will be.
2. "Overlearn" the response so that finally the adequate cues are mere vestiges of the needed cues before "overlearning." Thus

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[26] Kingsley, *op. cit.*, pp. 464–465.
[27] McGeoch, *op. cit.*, pp. 501–505.

the chances of functioning when conditions are adverse are improved.

3. Practice under conditions as similar as possible to those in which dependable performance will be tested.
4. If and when performance fails in spite of these precautions, recapture more of the conditions, external and internal in which performance was dependable.

The internal factors in the situation are very important. Their importance has been neglected in the discussion of Part II so far. This must now be remedied in chapter eight under the topic of adjustment.

CHAPTER VIII

LEARNING AND ADJUSTMENT

Introduction
The Nature of Motivation
The Functional Autonomy of Motives
The Learning of Motives
Learning to Want
Many Feeling Meanings Do Not Motivate
Factors Which Limit Control of Motivation Development
Feeling and Striving as Related to Learning
Part II in Retrospect

Introduction

The plan for chapters six, seven, and eight is to use the concept of learning presented in chapter five, that is, to test its pertinence to the important common concerns of educators. The division of this test into chapters six, seven, and eight might at first glance look like a division into the development of mind, body, and spirit. The lack of correspondence is soon apparent, as is the inadvisability of trying so to divide man's development. Problem solving comes first in Part II simply because the development of problem-solving ability is an important objective of education. A theory of learning which is not useful in this task must be modified. Then comes a consideration of all those objectives which may be lumped together because we think of them as achieved through practice. Usually the validation or usefulness of learning theory has been tested chiefly against this criterion. It is a very important criterion. Hence, although it is very necessary that a clear relation be evident between a concept of learning and problem solving, the concept of learning must still be examined for its usefulness in the area of practice, the more traditional criterion.

We found that the novel situation and the repetitive are not as distinct as they are often described. Before we were through our examination in chapter seven, we were, under the topics "Multiple Learnings" and "Forgetting," back into the subject matter of chapter six. This is not surprising. We bring to *every* situation, including therefore those we call problem situations, all that we have learned, however well memorized, however much or little automatized. We even *practice* problem solving, and seek to develop problem-solving habits and skills. On the other hand, many of the tasks which we speak of practicing were certainly problems in their early stages. Certainly, many of them remain highly creative in their finished performance.[1] Man's behavior cannot be sorted neatly into such categories as memory, skill, habit, and intelligence. Under any one as a topic, all that need be said about the others could be logically justified. The same is true of the word "adjustment." Perhaps it could be said with even more justification, for an all-embracing meaning is often attached to the word "adjustment." However, the use of the word "adjustment" in the title of this chapter is not intended to suggest such an all-embracing coverage. The present chapter is designed merely to supplement chapters six and seven with a consideration of the relationship between learning on the one hand and feeling and striving on the other. The chapter is designed to indicate briefly the four tasks which remain in connection with Part II: (1) to see the feeling and striving aspects of adjustment as affected or effected by learning, (2) to see learning as influenced by them, (3) to precede this inquiry with an examination of the "nature" of motivation, and (4) to follow (1) to (3) with a re-examination of Part II.

The Nature of Motivation

The word "motive" could be defined as synonymous with stimulus situation. In that sense, since the use of the word "response" implies stimulus, it also implies motivation. In other words, since all behavior is preceded and influenced by a pattern of stimulation, all behavior is motivated. The only exception which could be taken to such a definition would be that we would then need a new term for the group of stimulating situations which are usually in mind when the word "motivation" is used. It seems better to continue to use "motivation" to refer to such aspects of the stimulus situation as are due to, or resemble those due to physiological need. Hunger activates the living organism until the situation responsible for the stimulus pattern (referred to as motivation) is changed, relieved, or satisfied. Motivation, then, is the sort of stimulation which we interpret as need and which tends to persist and to excite the organism as long as the sense of need is felt.

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[1] Budge, J. D., *Budge on Tennis,* New York, Prentice-Hall, 1946, pp. 122–129.

In 1908, McDougall[2] thought that psychology was about to throw a great deal of light upon the nature of motivation by exploring the role of instincts in accounting for it. He thought that "the recognition of the full scope and function of the human instincts" would be recognized as "the most important advance" of the psychology of his time. The trend proved to be in the opposite direction. Learning, not instinct, proved to be the contributor to the psychology of motivation. The following statement, written twenty years after McDougall expressed his opinion, was then, and is now, the prevailing psychological opinion. Dashiell wrote:

> We have traced the original sources of motivation and energizing of human behavior back to tissue conditions of the organism. . . . if we observe the story of child development . . . we find that the most basic and immediate wants of the child-animal become progressively modified little by little into the mature and sophisticated interests and aims of civilized manhood. . . . [The story] is in essence a story of learning.[3]

But to say that in general a learning theory of motivation has replaced an instinct theory is not to say that there are no differences of opinion. The belief in an instinctive or native set of motives dies hard. And it is not surprising that it should be so.

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[2] McDougall, W., *Social Psychology*, Boston, Luce, 1908, pp. 24–25.

[3] From p. 248, Dashiell, J. F., *Fundamentals of Objective Psychology*, Boston, Houghton Mifflin Company, 1928, by permission of the publishers.

Within a given culture, certain forms of motivation may be expected to be learned by most people. The frequency with which one then finds such a motivation pattern leads one to think that it is basic to man's nature. The habit of explaining man's behavior by calling it his "nature" gives ground slowly. Consequently, there are many lists of the basic motives of men. The important thing to remember about such lists is the probability that "basic" means "commonly observed."

The best hypothesis upon which to proceed is that there is only one *basic* motivation, and that it is not channeled along specific lines as are adult motivation patterns. According to this hypothesis there is originally only an excitement to activity as a result of physiological need. To this hypothesis I would suggest no exceptions. The "frustration to aggression hypothesis,"[4] for example, seems like a backward step. According to this hypothesis, "aggression is always a consequence of frustration. More specifically, . . . aggressive behavior always presupposes . . . frustration, and contrariwise, . . . frustration always leads to some form of aggression." Now if this word "aggression" had meant for the authors merely a "heightening of activity," the hypothesis would be quite consistent with the basic postulate stated above. But that was not the case. For, according to the authors, "any such sequence of behavior, the goal response to which is the injury of the person toward whom it is directed is called aggression." And again, "aggression is . . . an act, whose goal-response is injury to an organism." This hypothesis does not seem to be a valid observation concerning the very young child before learning has had much influence upon motivation. Suppose, for instance, that a hungry infant in the arms of mother or nurse is deprived of its bottle while the infant is still hungry. This would be a frustration, but would the infant be motivated to injure? If injury in such a situation is the "goal response," the test is for injury to quiet and satisfy the infant, in other words to terminate the activity provoked by the frustration. This, it is believed, would not be the case. If the infant by chance did injure the parent or nurse, as it might, by thrusting a fist into an eye, would the injury afford any satisfaction to the infant, or terminate its crying or struggling? It would, it would seem, mean nothing. Only the bottle would terminate the frustration-provoked activities unless they were terminated by fatigue or sleep or some distraction. No one would deny the frequency with which frustration provokes aggression, but there is a very important distinction between, on the one hand, observing the frequency or near universality of a way of behaving, and, on the other, asserting or even implying that that way of behaving is inevitable because basic to man's nature. It needs saying over and over and with emphasis that many of the things which we are in the habit of attributing to man's nature are more properly attributable to his nurture.[5]

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[4] Dollard, J., Doob, L., Miller, N., Mowrer, O. H., and Sears, R., *Frustration and Aggression,* New Haven, Conn. Yale University Press, 1939, pp. 1, 9, 11, by permission of the publishers.

We start then with the bare assumption that need, whether because of deprivation or of frustration, excites or intensifies activity, and that gradually under the influences of our culture and man's capacity for learning, this physiological basis is differentiated into motivational patterns. In spite of such commonness of pattern as comes from growing up in the same culture, there is to be expected a great deal of individual uniqueness, both because of the uniqueness of the individual's environment and because of his uniqueness as a physiological organism.[6] Here we find reinforcement for the opinion to be offered in chapter thirteen that there is no easy way to know the individual pupil whose education we direct. Those who have a favorite list of the "basic" motives should beware lest they use it as a substitute for the needed intimate knowledge of the individual pupil.[7] He may or may not be motivated as the list would indicate. The probabilities are that the list is a poor substitute for the needed knowledge of the pupil's motives.

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[5] According to Britt, S. H., and Janus, S. Q., "Criteria of Frustration," *Psychological Review*, 1940, 47:451–470, O. H. Mowrer, one of the authors of *Frustration and Aggression*, wrote in a personal communication, "Aggression in its primitive, uninhibited form, consists of an energization of the behavior in progress . . ." This definition is free of the feature to which exception was taken above. Quotation from pp. 462–463 by permission of the American Psychological Association.

[6] Murphy, G., *Personality: A Biosocial Approach to Origins and Structure*, New York, Harper, 1947, pp. 763–881.

The Functional Autonomy of Motives

Along with the still common recourse to a set of "basic" motives is the belief that it is necessary to trace everyone's behavior back to these "basic" motives. Allport[8] has called this belief "the fetish of the genetic method." It isn't that he denies the importance of "historical" explanation (see chapter three) for the general understanding of personality. His protest is against the belief that in your dealings with a given pupil you necessarily need to have made such an historical analysis in order to proceed intelligently. It is necessary for research purposes and may be advisable in certain cases as a guide to procedure. But his point is that the only certain need is to know the present pattern of motivation. Regardless of the developmental story behind that pattern, the pattern has a functionally autonomous importance and provides an understanding upon which to project further educational effort. In other words, to understand a child so as to direct the development of a desirable pattern of motivations, fortunately it is not necessary to trace the history of the development of the present pattern. It may be helpful to know some things about that history, but all that is necessary is (1) to know the child's present pattern of motivation (see Part III), and (2) to know how learning modifies and develops motives. Is the concept described in chapter five adequate for the latter need?

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[7] See p. 756 of P. T. Young's article on "Motivation" in *Encyclopedia of Educational Research*, rev. ed., New York, Macmillan, 1950, pp. 755–761.

[8] Allport, G. W., *Personality*, New York, Holt, 1937.
See also, Pear, T. H., "Are There Human Instincts?," *Bulletin*, John Rylands Library, March, 1942, 27:137–167.

The Learning of Motives

An examination of the learning of the ways of behaving which we speak of as phases of personality adjustment reveals no new basic aspects of the learning process. The concepts presented in chapter five, and related in chapters six and seven to problem solving and practice, are pertinent and adequate.

The situation of the infant, whose need provokes activity, parallels the situation which was considered in chapter six as trial-and-error behavior in the puzzlelike problem situation. Those responses which do not alleviate the need are in time eliminated because by-passed through the earlier (anticipatory) cueing of the successful response. As the process continues, the cueing becomes not only prompt but automatized, and then even a slight need may be depended upon to eventuate in the successful response. The need is now channeled to a way of satisfying it.

With this stage reached, another and important learning outcome is possible and probable. As soon as the need is felt and before he can satisfy it, the learner will think of the things he is about to do or get in order to satisfy his need. This thinking is "anticipatory." Even though the satisfaction of need is a long-drawn-out process, the learner is likely to make immediately whatever parts of the successful response can be made at the outset. Being possible and cued to the feeling of need, they will be made early. But, and here is where an important circularity of relationship[9] becomes possible, what we have referred to as stimulus (the feeling of need) can become cued to what we have referred to as response (the thought of what is to satisfy the need). In other words, thereafter, to think of whatever satisfied the need is to reactivate a feeling of need, and thus to initiate motivation. So, for instance, the mere thought or sight of a favorite food may motivate eating, conditions permitting, whereas originally a physiological need had to initiate the trial-and-error behavior which was later channeled into a definite pattern.

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[9] Holt, E. B., *Animal Drive and the Learning Process*, New York, Holt, 1931, pp. 38–40, 221–225.

Learning to Want

But motivation would seem relatively simple if it did not in its development soon begin to lose its clear relationship to obvious physiological needs. A generalized feeling of need or want or desire or yearning is abstracted from the various experiences in which it is felt, just as ideas or muscular controls are abstracted.[10] Just as attention can be called to a concept such as circularity by reference to a well-chosen set of objects, alike in that respect and different in others, so the feeling of needing to do something in order to get something that is wanted can be brought to attention and later activated by whatever language or other behavior cues learning has produced for the given learner.

Thus abstracted, this feeling of wanting is bespoken designedly by the parent, the teacher, the religious worker, the salesman, the advertiser, the candidate, and the advocate of every cause. Apart from the more intellectual aspects of the plea, the success or failure of the effort seems in no small degree to depend upon the learner's evaluation of the person who is trying to arouse desire for his cause.

And, of course, in addition to these many purposeful efforts, there are the even more numerous occasions when unwittingly, in the learner's presence, things, or thoughts, or ways of living are portrayed as eminently to be desired. In this connection, our consideration of the nature of the learning process prompts a reminder which educators cannot afford to ignore. It is that if the conditions are right, a line of conduct, a way of living may be felt by the learner to be so desirable that the single experience may exercise a profound influence upon his life, a fact which it is easy to illustrate.

Grenfell wrote:

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[10] Gates, A. I., Jersild, A. T., McConnell, T. R., and Challman, R. C., *Educational Psychology,* New York, Macmillan, 1948, pp. 430–438.

> None of our family on either side, so far as I can find out, had ever practiced medicine. My own experience of doctors had been rather a chequered one, but at my father's suggestion I gladly went up and discussed the matter with our country family doctor. He was a fine man, and we boys were very fond of him and his family, his daughter being our best girl friend near by. He had an enormous practice, in which he was eminently successful. The number of horses he kept, and the miles he covered with them, were phenomenal in my mind. . . . The only remaining memory of that visit was that the old doctor brought down from one of his shelves a large jar, out of which he produced a pickled human brain. I was thrilled with entirely new emotions. I had never thought of man's body as a machine. That this weird, white, puckered up mass could be the producer or transmitter of all that made man, that it controlled our physical strength and growth, and our responses to life, that it made one into a "Mad G.," and another into me—why, it was absolutely marvelous. It attracted me as did the gramophone, the camera, and the automobile.
>
> My father saw at once on my return that I had found my real interest, and put before me two alternative plans, one to go to Oxford, where my brother had just entered, or to join him in London, and take up work in the London Hospital and University, preparatory to going in for medicine. I chose the latter at once—a decision I have never regretted.[11]

Thomas Mellon wrote in his autobiography: [12]

> It was about my fourteenth year, at a neighbor's house when plowing a field we had taken on his farm for buckwheat, that I happened upon a dilapidated copy of the autobiography of Dr. Franklin. It delighted me with a wider view of life and inspired me with new ambition . . . I had not before imagined any other course of life superior to farming, but the reading of Franklin's life led me to question this view. For so poor and friendless a boy to be able to become a merchant or a professional man had before seemed an impossibility; but here was Franklin, poorer than myself, who by industry, thrift and frugality had become learned and wise, and elevated to wealth and fame. The maxims of 'Poor Richard' exactly suited my sentiments . . . I regard the reading of Franklin's *Autobiography* as the turning point in my life.[13]

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[11] Quoted from p. 38, Grenfell, W. T., *A Labrador Doctor*, Boston, Houghton Mifflin Company, 1919, by permission of the publishers.

[12] *Thomas Mellon and His Times*, printed for his family and descendants, by William G. Johnston and Company, Printers and Stationers, Pittsburgh, 1885.

[13] The use of this illustrative material is somewhat inappropriate in this book, which in most respects leaves teaching to the instructor. However, the author could not forego a few illustrative emphases. In chapter five, the picture of reversible rivet heads (Figure 1) is to remind the reader that all responses are

Learnings in the area of personality and character development are not necessarily slow and insignificant. If a distinction is to be made, it is that the direction of such development is difficult to control, rather than that learning must be slow.

Many Feeling Meanings Do Not Motivate

Many efforts in the interest of character or citizenship education result in a semblance of success but are worth little as motivation. There are many things we say we like or dislike but do nothing to secure or avoid. Asked, "What is your attitude about this and that?," you give a positive or negative reaction, but it would be difficult for an observer to have inferred your attitude from anything the attitudes motivated you to do. Asked to describe his interests, a person may say, for instance, "I like music." To locate the answer, he may have had to review his own behavior to make this observation, and an observer would have had to infer the answer from the fact that if music is played the person is not bored by it. The situation is very different for one who often wants to hear music and takes steps to satisfy the want. Similarly, in the fields of character and citizenship we may have succeeded in getting pupils to think approvingly of a way of living without developing any worthwhile compulsion to practice it.

Factors Which Limit Control of Motivation Development

For the development of intelligence, probably differences in the nervous system are important. In the development of certain skills, skeletal and muscular patterns are important determiners. Perhaps as affecting the development of the motiva-

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more learned than we are apt to realize. In chapter six, the drawing which pictures either an old or a young lady (Figure 2) is to remind the reader that responses depend upon what feature of the situation is most focal in its influence. The above illustrations are to remind that if conditions are right, people may be changed in vitally important ways by learnings from single experiences. And in one more case (chapter eleven), illustrative material will be used. The hope there is that the reader will remember that a person of ordinary general ability may develop extraordinary ability along specialized lines if conditions are favorable. These things are worth emphasizing for even the advanced student.

tional pattern, the amount of available energy and the explosiveness with which it is released are as important. It is not known to what extent these physiological factors are related to learning in the areas of character and citizenship. But several investigators have noted the possibility that delinquents are above average in the extent to which they are physiologically motivated. Harris [14] said the motives of delinquent boys were similar to the play interests of nondelinquent boys. Partridge [15] saw nothing abnormal in their craving for action, adventure, companionship, and approval. Porteus [16] reported more impulsive reactions by criminal than noncriminal adults, and by delinquent than nondelinquent boys and girls. Redl [17] thought it advisable to write an article in which to call attention to "what's right with our 'delinquent' children." In his experience, it is often said of a delinquent "he sure had guts." He has often seen a fine group loyalty, a valuable independence of growth, and a crusading spirit which would be much prized in the right cause. Stern [18] found a delinquent group more active, energetic, and outgoing than a nondelinquent group. Sheldon [19] noted the frequency among his two hundred delinquents of that quality or those qualities which make heroic living possible, especially among his cases 106 to 164. Sheldon frequently describes these delinquents as having an abundance of energy, as craving activity, and as finding keen satisfaction in the taking of long chances and dangerous risks.

These remarks are not intended as an "explanation" of delinquency. That calls for an examination of our whole culture as well for an examination of the psychology and physiology of the individual. They are offered merely to support the possibility that individual differences in the physiological aspects of motivation may be important differentiating factors in personality and character development.

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[14] Harris, D. B., "Relationships among Play Interests and Delinquency in Boys," *American Journal of Orthopsychiatry*, 1943, 13:631–638.

[15] Partridge, E. D., *Social Psychology of Adolescence*, New York, Prentice-Hall, 1938, p. 327.

[16] Porteus, S. D., "O-Scores, Temperament and Delinquency," *Journal of Social Psychology*, 1945, 21:81–103.

[17] Redl, Fritz, "The Virtues of Delinquent Children," *Understanding the Child*, 1943, 12:3–6.

[18] Stern, M., "Some Differences between Neurotic Delinquents and Other Neurotic Children," *Smith College Studies in Social Work*, 1945, 16:62–81.

[19] Sheldon, W. H., *Varieties of Delinquent Youth*, New York, Harper, 1949.

Feeling and Striving as Related to Learning

Whatever research may reveal as to this possibility, there is no doubt as to the important influence of feeling and striving upon learning. If a response is strongly emotional, learning outcomes which might otherwise be expected are rendered less likely. This is so because the likelihood of a feature of a situation becoming a cue depends upon the extent to which it is focal in its influence. But the feeling itself is likely to be the influential core and to remain so for some time. To the extent that this is the case, the other features in the situation go relatively unnoticed.

This preventive influence is a matter of concern for the counselor who, "nondirective" [20] for the time being at least, wants the counselee to learn some things about himself, to solve his own problem, and possibly thereby to learn something about solving one's personal problems. His task is essentially a de-emotionalizing one. The counselor creates good problem-solving conditions. For the first time in a nonemotional atmosphere, the situation is seen by the counselee from various angles, an exploration previously impossible because feeling was the dominant or attentive core of response.

Similarly, in all areas of learning, as well as at all ages, the solution to many a problem has been blocked by fear and by embarrassment. Such interference obtains in every situation where it is important that attention be free to roam in an exploratory fashion. Although fear and embarrassment thus prevent some learnings which would otherwise take place, unfortunately, such situations are not without a learning outcome. One learns more certainly from each such situation that it is a situation to fear or one in which to be embarrassed.

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[20] Rogers, C. R., *Counseling and Psychotherapy*, Boston, Houghton Mifflin, 1942, pp. 89–90.

The feeling or emotional component of response is not in all ways negative in its influence. In some situations, when the skills needed are well automatized, the stronger the feeling of need, the more energy is made available. A strong feeling of need is also valuable when, because of prior learnings, that need is directed toward a particular goal. Strong motivation rules out many claims for attention which, but for singleness of purpose, would be diverting influences. Because strong motivation is the dominant or highly cored aspect of behavior, it thus exercises a great deal of influence upon the course of learning. It prevents such learnings as would come with the claims for distraction, and allows only those which come from instrumentally related behavior.

Part II in Retrospect

It should therefore be clear that in emphasizing attention as the dominant or cored aspect of behavior, motivation has not been de-emphasized. The core of behavior referred to as attention is often, if not usually, motivational in character. The importance of purpose is not unrecognized. Rather its great influence and significance (upon which stress will be placed in the concluding chapters) have been integrated into a larger concept. This larger concept not only embraces the role of purpose in learning, but it also provides for certain phenomena of learning which are sometimes neglected because of the obvious importance of motivation. The importance of motivation in an all-round psychological description has tended to distract attention from the essential nature of the learning process.[21]

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[21] "Set," long recognized as an important factor of psychology (E. G. Boring, *A History of Experimental Psychology*, New York, Century, 1929), is again receiving emphasis (H. F. Harlow, "The Formation of Learning Sets," *Psychological Review*, January 1949, 56:51–65). The plea made above is not that set is unimportant but simply that learning be seen as fundamentally the same process both where set is obviously important and where it is not. The reader who finds it difficult to recognize the importance of motivation and at the same time to hold a nonreinforcement theory of learning may find an example in Young, P. T., "Food-Seeking Drive, Affective Process, and Learning," *Psychological Review*, March 1949, 56:98–121, especially pp. 111–116, and No. 5, p. 120.

In Part II, the concept of learning as cue production has been tried out or used in relation to some of the learnings which are an important part of education. It is imperative that each reader similarly try out his basic concept of learning, with more or less rigor according to his interest and ability. A broadly useful psychology of learning is not come by easily. Except as it is abstracted from many learning situations it will not serve in many situations.

From their review of the field, many students of learning do not find it possible to see in the great diversity of learning phenomena only a single concept of learning.[22] If, similarly, the reader wishes to emphasize differences, a good case could be made for a list of three kinds, namely, the acquisition of meanings, memorization, and automatization. Even so, it should be conceded that the three kinds of learning are three kinds of relationship between the cue produced and the previously needed stimulus pattern of which the cue is a reduction. In the acquisition of meaning the reduction is a sort of qualitative reduction. After learning the meaning of the word "green," hearing can serve as a cue for a response previously dependent upon hearing and sight. In automatization, on the other hand, the cue produced from the sixtieth response is likely to be called a quantitative reduction of the necessary stimulus for the fifth-ninth response. Still another relationship exists between the final cue for a memorized performance and the originally necessary promptings. They constitute a series with a fixed temporal order. The reduction in this case might be said to be reduction of or elimination of the segmented character of the necessary stimulus.

[22] Birch, H. G., and Bitterman, M. E., "Reinforcement and Learning: The Process of Sensory Integration," *Psychological Review*, September 1949, 56:292–307.
Hilgard, E. R., *Theories of Learning*, New York, Appleton-Century-Crofts, 1948, p. 326.
Mowrer, O. H., "On the Dual Nature of Learning—A Reinterpretation of 'Conditioning' and 'Problem-Solving,'" *Harvard Educational Review*, Spring, 1947.
National Society for the Study of Education, *41st Yearbook*, Part 2, *The Psychology of Learning*, Bloomington, Ill., Public School Publishing Co., 1942; K. Lewin, p. 220; T. R. McConnell, p. 256.
Tolman, E. C., "There Is More Than One Kind of Learning," *Psychological Review*, 1949, 56:144–155.

There is some merit in pointing out these differences, especially since it is very important to know their bearing upon the real or supposed need for practice. But if the differences are superficial, there is merit in seeing these "kinds" as manifestations of a single process. This they could easily be.

The distinction between the qualitative and the quantitative is not necessarily a basic one. It may be more like the practical distinctions we make in a continuum, such as for different colors, or like the "familiar" and the "novel," or the "problem" and the "puzzle" situation. The hypothesis is offered that (1) the more novel a situation, (2) the more cored behavior is, and (3) the more striking the learning in its effects as observed by either the learner or another, the more likely the cue will be thought of as qualitatively related to the necessary stimulus pattern for which it will suffice, and the more likely we are to say learning took place rapidly. Reversing the statement, (1) the more familiar or repetitive the situation, (2) the less cored the behavior (i.e., the less characterized by a concentration of attention), and (3) the less obvious the learning,[23] the more likely the cue will be thought of as a quantitative reduction of the previously necessary stimulus pattern, and the more likely we are to say that learning is taking place slowly. Since we have assumed a continuum of novelty for the learner in the situation in which he finds himself, we find no justification for any fundamental distinction in learning because of its relation to this continuum.

The continuum with respect to novelty was assumed in chapter six. The time dimension has not been considered, but a similar position is taken with regard to it. We began, in chapter five, with an assumption of the psychological interrelatedness or unity of all phases of behavior "at a given time." Then in the third postulate we considered the psychological unification which is possible even over a considerable span of time using a different word, "continuity." This separate comment under different labels is another case of apparently dichotomous thinking where no fundamentally sharp distinction is thought to exist. It is believed that there is no psychological unit, no behavior which does not have a time dimension. We believe that we are considering psychological units which vary from the very short to the very long. The hypothesis offered in connection with the time-dimension continuum is that all learning has the characteristics of memorization in proportion to the length of the unit, but that neither the learner nor another observer can note them in the case of the shorter units.

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[23] Less obvious, but by no means unimportant. Only so could low-cored engrams be provided, engrams which can be reactivated by minimal cues in spite of distracting claims for attention.

Learning is, then, both one and many because of (1) the variation in the novelty of the situation for the learner, (2) the variation in the time span involved, and (3) superficially because of the varying prominence in the behavior of those components we call thought, feeling, and action. Whether it is a quick all-or-none matter or a gradual process is not an "either-or" question. Some of the most prized aspects of development can be learned quickly if the conditions are favorable. Some must come slowly in the course of practice. Some come slowly because of unfavorable conditions. If practice is recommended it should be recommended for a reason, such as:

1. To secure dependability of performance
   a. by automatization (through practice with low-coredness),
   b. by providing for cue variety.
2. To bring about a needed preparatory familiarity
   a. with materials to be memorized,
   b. with materials to be incorporated into higher-order skills,
   c. with materials of a multiple-learning task.
3. To direct attention as needed—often slow because of the difficulty involved in the direction of attention.
4. To secure favorable timing—sometimes slow because of the inability to provide for the necessary timing except by chance in the course of varied performance.
5. To secure good form through the by-passed elimination of useless or poor aspects of performance (gradual because attention and timing uncontrolled).

As described in Part I, learning is an extremely valuable concept around which to integrate the facts of psychology. No attempt has been made here to consider all those facts. Also, as has been pointed out before, no effort has been made to describe behavior nonhistorically. The maturational aspects of development have been ignored. But, even with these limitations, our consideration of learning has embraced and interrelated much. This Part II tryout of a concept of learning in the areas of problem solving, practice, and adjustment shows, we believe, that a learning approach as one of the approaches to psychology has much to commend it. The concept described and used is offered as a tentative or working hypothesis for use in education.

PART III

THE INDIVIDUAL LEARNER

IN A SENSE, knowing "the learner" includes knowing how his learning takes place. In that sense, we have been considering "The Learner" from the outset. There is, however, a fairly sharp distinction to be drawn at this point. Parts I and II were designed to help the educator know things which are true of all learners. Part III, on the other hand, is devoted to the problem of getting the knowledge which is unique for the individual learner at a given time and place. Parts I and II make clear that much needs to be known about the individual if his learning is to be efficiently directed.

The labels "Achievement," "Ability," and "Personality" are not used in the titles of the chapters in Part III with any idea that the learner can be neatly divided into such compartments, nor with the intention of giving the terms precise meanings. Any one of these terms might be defined so as to embrace all that we need to know about the learner. They are used with misgivings, in the belief that their connotations will suggest the emphases within the several chapters.

"Achievement" is used in the title of chapter nine because what is presented there is pertinent when what is desired is knowledge of progress or status in the areas of the school's traditional effort. "Ability" is used in the titles of chapters ten, eleven, and twelve because these chapters refer to procedures primarily designed to provide a basis for prognosis. Chapter thirteen, which is called "Personality," is an effort to round out the discussion of evaluation as it is needed if all the areas of development are matters of educational concern.

CHAPTER IX

THE MEASUREMENT OF ACHIEVEMENT

Educational "Measurement"
Testing as a Part of Teaching
Limited Coverage
Some Mistakes to Avoid in the Interpretation of Scores
Minimizing Errors
Reliability
Validity
Test Construction
The Weighting of Part Scores
The Meaning of Scores
Summary

Educational "Measurement"

Some writers [1] question the appropriateness of the use of the word "measurement" in education. Can knowledge or skill be measured from a zero knowledge or skill in terms of obviously equal and interchangeable units? One can get zero on a test but does that mean "no knowledge" in the area tested? Usually not. And it may or may not mean "no learning in that area during a specified period." Usually no thought is given to the definition of a zero point. The test maker and user are satisfied to rank those tested as to their knowledge or skill. But even to do this an assumption must be made which in a strict sense is untenable. The assumption is that each little test passed (i.e., each question answered or direction followed) is a unit of knowledge or skill equal in amount to any other. We know that the spelling of one word is not equal to the spelling of another as evidence of spelling ability, and that one example in arithmetic is not the equal of another, but we count the "rights" and call the number a "measure" of ability. We cannot say that A is more able than B, and that B is more able than C except on the basis of such an assumption.

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[1] Smith, B. O., *Logical Aspects of Educational Measurement*, New York, Columbia University Press, 1938.
Brubacher, J. S., *Modern Philosophies of Education*, New York, McGraw-Hill, rev. ed., 1950, pp. 9, 240–245.
May, M. A., "Ten Tests of Measurement," *Educational Record*, April, 1939, pp. 200–220; "Evaluating Testing and Measuring in Psychology and Education," *Twenty-Ninth Annual Schoolmen's Week Proceedings, University of Pennsylvania Bulletin*, June, 1942, pp. 402–410.
Thomas, L. G., "Mental Tests as Instruments of Science," *Psychological Monographs*, 1942, Vol. 54, No. 3.
Stevens, S. S., "On the Theory of Scales of Measurement," *Science*, June 7, 1946, Vol. 103, pp. 677–680.

It would be foolish to refuse to use the scores obtained, merely on the basis of the criticism which can be made of this underlying assumption. To the extent that the scores serve a useful purpose in education, let them be used. If a state highway department wants a "measure" of traffic on a road, a count of passing cars, regardless of size, weight, or speed, affords a practical basis for decision. Similarly, in many areas, for instance by Western Union in charging for telegrams, item differences are ignored and a count is used as a "measure." In fact the question could be raised whether the crudities which are so very obvious in educational "measurement" are not present in some degree in all measurement.

Testing as a Part of Teaching

Because of the measurement movement in education, the word "test" is now thought of as a whole series of questions or exercises to be presented to the learner. But since the purpose of the series is to secure a measure, the situation would be described better if the series were called a measuring instrument made up of many tests.

The word "test" so used is a situation admitting of only success or failure, knowing or not knowing, being able or not being able to do as directed. When "test" is defined in this way it may be said that all teachers test in one way or another. Some do not go to much trouble to set up situations for the purpose, but even these teachers note such evidences of learning or lack of it as are available. Ask concerning a pupil, "Can he write his name?," "Can he multiply 18 by 14?," "Can he describe the tax situation as it led to the American Revolution?," "Can he identify Dvořák's Fifth Symphony?," and the teacher who has tried to teach these things knows or has a basis for an opinion. Teachers want to know how well they are succeeding. Often the questions they ask are designed as tests. The word "test" so used is any situation whether designed or merely used by the teacher to provide evidence of learning. Some teachers get a great deal of such evidence while teaching. One of these teachers, asked whether he made use of tests, might reply, "very little," because he would give the word "test" its more common meaning. It is a mistake to think of the use of tests in this more common sense of the word as designed to replace the tests which are made less obviously in the course of teaching.

The use of tests as it has developed in the course of the testing movement should be thought of as supplementing, not replacing, testing in the course of teaching. Testing programs may provide all the information needed by the principal, the superintendent, and the board of education. They can add to the knowledge which teacher and pupil would have. But they cannot give the teacher and pupil the fullness and immediacy of evaluation which is a part of teaching and learning. The testing program has a more general objective than testing in the course of teaching and learning. The latter evaluates in terms of a particular effort. The former is a small sample of many such particulars. The question is not, "Do you know this?" or "Can you do this?," so much as it is, "How much knowledge do you have in this area?" or "How much skill have you developed in this area?"

Limited Coverage

It has been pointed out that efforts to measure in education are crude as compared with measurement at its best, and that they cannot provide the full and immediate knowledge which the teacher and pupil need. Another criticism which must be made of testing programs is that they cover best the most minute outcomes of education. This criticism, fully developed, applies to interests, attitudes, appreciations, and adjustments, etc. which traditionally are more commonly thought of under the heading Personality (see chapter thirteen) than under Achievement.

Particularly within the so-called intellectual objective which has had longer acknowledgement in education, testing programs are likely to emphasize the minutia.[2] Tyler [3] has shown a ranking of students according to the amount of knowledge to be a poor approximation to a ranking of the same students according to their ability to use that knowledge. This disparity does not always exist. Whether it does or not depends upon the teaching the pupils have had. Tilton [4] reported a very high agreement. But the important thing is that such an agreement may not be taken for granted.

Some Mistakes To Avoid in the Interpretation of Scores

Since many schools regularly administer testing programs, practically everyone in school work has need for training in the interpretation of scores. It is a very common mistake to consider the score more accurate than it is. There is no kind of measurement which if repeated will always give the same result. Each needs to be repeated so that its inaccuracy may be measured.

The measure of inaccuracy which has had the longest history is known as the *probable error*. It is a very simple concept, and in a natural science laboratory is easily obtained. The measurement, the error of which is in question, is made many times. The results are added and averaged. The average is thought of as the true measure for lack of better information. The departure from the truth, or discrepancy, is noted for each measurement and these deviations are listed in order of size without sign. These discrepancies are thought of as errors. The median of the errors is called the *probable error.*

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[2] For a description of efforts to remedy this emphasis, see: National Society for the Study of Education, *45th Yearbook*, 1946, Part 1, *The Measurement of Understanding*.

[3] Tyler, R. W., "The Relation between Recall and Higher Mental Processes," Chap. 2 of Judd, C. H., *Education as Cultivation of the Higher Mental Processes*, New York, Macmillan, 1936.

[4] Tilton, J. W., *The Relation between Association and the Higher Mental Processes*, New York, Bureau of Publications, Teachers College, Columbia University, 1926.

In education one aspect of this procedure cannot very well be followed. It is not practical to measure many times because of the likelihood of the development of a poor attitude on the part of those tested. However, the concept may be illustrated with achievement-test data. Suppose an arithmetic test were given ten times to the same boy with the following [5] results: 5–3, 4–7, 5–1, 3–8, 5–7, 4–8, 4–3, 6–2, 5–2, and 4–9. The average of these scores is 5–0. The errors are 3, 3, 1, 12, 7, 2, 7, 12, 2, and 1 months. There are 2 one-month errors, 2 two-month errors, 2 three-month errors, 2 seven-month errors, and 2 twelve-month errors. The median [6] error is 3 months.

When, after seeing such a distribution of errors, one sees a score made on this test he has some idea of what the error of measurement may be. Possibly the first score (the only one available) is the lowest the pupil would make in many trials. Possibly it is the highest. In other words, the error could be 12 months in either direction. The obtained score is just as likely to be in error by more than 3 months as it is to be in error by less than 3 months. Errors are seldom more than 4 times the probable error. With these error data in mind one would realize that the pupil might test in the low sixth grade today and the high third grade tomorrow or vice versa, although it is not likely that his first two scores would be the two most in error.

The scores used above were fictitious but they do not exaggerate the amount of uncertainty involved in standardized testing. The makers of the Stanford Achievement Test commendably indicated the probable errors on the form on which the scores for a given pupil are to be graphed. The 10 probable errors, one for each of the 10 tests in the battery, average about 3 months of grade-location scores at the fifth-grade level and about twice that at the eighth-grade level. This amount of uncertainty may be expected in the use of any of the good achievement-test batteries. In other words, among the results from the achievement testing of an eighth grade, there will be a few grade-location scores for the several areas tested which are in error to the extent of 2 grades or more. Since any one score is as likely to be more than 6 months in error as it is to have less than that amount of error, the odds are in favor of any score being in error by more than a half grade. Lacking such information, people are likely to accept standardized test scores as more accurate than they are.

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[5] The scores are to be read 3 tenths or months of the way through the fifth grade, 7 tenths or months of the way through the fourth grade, etc.

[6] The median is a value such that half of the values are above it and half below it.

Measures of improvement from one testing period to another are even more uncertain because their error is a combination of the errors of the before and after scores. The error of a difference between two scores may be as much as 1.4 times the error of one of them.[7] There are still larger errors involved if the gain made by John Jones is compared with the gain made by Mary Smith, this comparison being a difference between differences. Averages for the class are more dependable because the errors average out. Also, as data accumulate over the years for a single pupil the possibilities for dependable observation are increased.

Measures of relative strength and weakness are likewise inaccurate. For instance, a pupil must have a science score very much higher than his other scores to give reliability to the observation that he is at his best in science. Or, on the other side of the picture, a pupil must make a reading score very much lower than his other scores to justify a conclusion that the pupil is relatively poor in reading.[8] Schlesser reported that of the possible observations of this kind only about one out of four may be made with practical certainty.[9]

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[7] This observation is based upon

(1) the relation $\text{P.E.}_{A-B} = \sqrt{\text{P.E.}_A^2 - 2r_{AB}\text{P.E.}_A\text{P.E.}_B + \text{P.E.}_B^2}$

(2) the assumption $\text{P.E.}_A = \text{P.E.}_B$

and (3) the observation that P.E._{A-B} is maximum when $r = 0$

Under these conditions $\text{P.E.}_{A-B} = \sqrt{2}$, or 1.4 times $\text{P.E.}_{A \text{ or } B}$

[8] Schlesser, G. E., "Development of Special Abilities at the Junior High School Age," *Journal of Educational Research*, 1946, 40:39–51.

As the concluding caution in this section on mistakes which are likely to be made in the use of scores, attention is called to a fact which the statistician calls regression.[10] Although plus errors have a tendency to balance minus errors in the group tested, there is a preponderance of plus errors in the scores of the highest-scoring pupils and a preponderance of minus errors in the scores of the lowest-scoring pupils. Hence when the group is retested, the scores of these pupils at the ends of the distribution regress toward the mean of the group. Not knowing this, one might easily be misled as follows: A group might be given a reading test, the purpose being to locate the poorest readers for a remedial program. After the program the remedial group is retested for a measure of benefit received. On the average, the group will make higher scores because of the regression, even if they have received no benefit from the remedial program. It would be necessary to allow for the regression effect before one could claim to have measured the effect of the remedial effort. If the highest-scoring pupils were similarly retested, they would show a loss, but school practice does not center as much attention upon this group. If it did, a similar correction in the other direction would be necessary.

Minimizing Errors

Not only can mistakes in interpretation be avoided, but the amount of error in measurement can be reduced. The error comes from three sources, the examinee, the examiner, and from sampling.

Least can be done to reduce the error as it originates in the examinee. He may remember today but not tomorrow. He may feel like trying today but not tomorrow. He may be preoccupied today and most efficient tomorrow, he may guess today and omit tomorrow. Such variables cannot be controlled. One can only standardize the directions and testing conditions and try to eliminate ambiguity from the questions.

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[9] Meaning that you would note the same result no matter how many times a similar battery of tests was administered.

[10] Thorndike, R. L., "Regression Fallacies in the Matched Groups Experiment," *Psychometrika*, 1942, 7:85–102.

The chief step which has been taken to reduce the errors of measurement due to the examiner is the use of objective tests. The term "objective" is used loosely for a variety of test forms. The term came into use because of the plans for scoring. They were designed to be so definite that only one scoring procedure and result would be possible. Tests like the multiple-choice and true-false are very objective, but a test like the completion test may be no more objective than the more traditional examinations with very definite plans for scoring.

If scoring cannot be so mechanized, there are two steps which the examiner can take to stabilize his appraisals. First, he can keep before him concrete examples of good, average, and poor work, or of good, average, and poor answers, as the case may be. Second, he can record his evaluations where they need not be seen, and evaluate the specimens or examination papers a second time.

Examples of great divergence between the marks assigned to the same paper by different readers are not surprising. Scores by two readers or judges may not be expected to agree as well as scores from two readings by the same person. Different readers have not the same standards in mind. For the same reason no one could evaluate pupil work the way the pupil's teacher would unless he has worked intimately with that teacher so as to know what the teacher values and has emphasized.

There are cases, however, when evaluations are wanted not against the particular set of values held by the teacher but against a more generally held set of standards. If a general impression of the student's work is wanted, an average of the judgments or readings by different examiners is indicated.

The easiest way to increase the stability of scores is to increase the sample of student behavior which is selected for appraisal. Usually this means simply making a longer test. Each item or question is a little test. Hence the score on the set of questions is like an average of many results, and the more results averaged the smaller the error in the average. But one question in one type of test is not equivalent to one in another type. A multiple-choice question, for instance, samples more of the student behavior to be evaluated than does a true-false question. This does not mean that it is necessarily better to use multiple-choice questions. It usually takes more testing time for a multiple-choice question than for a true-false question. For a given period of time to be devoted to testing, true-false questions might do as good a job of sampling as multiple-choice questions. Multiple-choice questions with four possible answers sample better than do those with only three. To convert a test made of three-choice questions into one of four-choice questions is equivalent to lengthening the test (i.e., increasing the number of items) by one-third.[11] To depend upon increases in the number of choices for better sampling is risky, for it is often difficult to write many good choices for a question. To pad out a test with poor choices only wastes time. If only three of five possible answers need to be considered seriously, the question is in fact only a three-choice question.

Reliability

To summarize the above section is to indicate the areas of unreliability with which the user of tests needs to be concerned. Unreliability exists because: (1) pupils do not perform the same way however alike we try to make the two occasions; (2) examiners cannot make the same appraisal on two occasions unless they follow a detailed scoring plan; (3) different examiners cannot make the same judgments unless both or all examiners are mechanically following a detailed scoring plan; (4) pupil behavior varies from sample to sample. The amount of difference in each case is the amount of unreliability involved. With the possible exception of the scoring of an objective test, it is never possible to achieve perfect reliability (i.e., no disagreement). The question always is, "How unreliable are the appraisals?"

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[11] Remmers, H. H., and Gage, N. L., *Educational Measurement and Evaluation*, New York, Harper, 1943, p. 206.

Each test user should know how much of the four kinds of unreliability is involved in his own evaluation practice. A repeated test objectively scored will reveal the variations in pupil performance. A rescoring of a test will provide a similar display of variation in examiner performance. A re-evaluation by another examiner will bring out examiner differences. Finally, a comparison of the results with two different but similar objective tests will illustrate a combination of pupil and sampling variation.

The last situation is the one for which the probable error is usually reported. A teacher who has made an objective test can easily find the probable error of a pupil's score on the test as follows: Score the test as if it were two tests. Think of all the odd-numbered items as composing one test, and all the even-numbered items as composing the other. List the pupils and their two scores. Compute the difference between the scores for each pupil. Distribute these differences without sign. The median of the differences is the probable error of a score on the total test.[12] Always the question, "How unreliable are the scores?," could be answered in this way by comparing two sets of such scores.

When it is a question of reliability, there is no reason for thinking that one of the sets of scores is better than the other. So far as is known, the pupil's performance on one occasion is as good as on another, the examiner's judgment as good at one time as at another, the judgment of one examiner as good as that of another, or the evidence from one test as good as that from a similar one. Reliability is a question of the sameness, stability, or consistency in the results of a repeated evaluative process. It is measured in terms of the amount of disagreement.

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[12] This was observed by Flanagan, J. C., in *A Booklet of Norms* for the Cooperative Achievement Tests, 1938. The student with statistical training will find that the median difference between two sets of similar scores is 1.4 times the probable error of a score on one of the half tests. He will also find that (very conveniently for the above purpose) the probable error of the whole scores (the scores on the whole test before it is divided into odd and even halves) is 1.4 times the probable error of the part scores (scores on odd or even halves).

Validity

Validity, like reliability, is not an all-or-none matter. We have a habit of saying, "This is reliable," "That is unreliable," "This is valid," "That is not valid." Actually, evaluation practices fall on a scale of reliability and on a scale of validity. There are no points on the scales, no critical tests of reliability or validity except as set by convention or the demands of a particular situation. It should be remembered then that usually our questions concerning our measures are, "How much unreliability is involved?" and "How valid are the measures?"

It is hard to draw a sharp line between questions of reliability and questions of validity. A question is one of validity to the extent that there is greater confidence in one of the evaluations than in the other. The one in which there is greater confidence is the criterion against which the other is judged. For instance, if it is desired to compare the judgments of an inexperienced reader with those of an experienced reader in order to find out how well the inexperienced reader can score papers, then it is a question of validity although it is an examiner-to-examiner comparison, described above as a test of a phase of reliability. Likewise, if scores on a new test are compared with those on a test which has proved its usefulness, it is a test of validity although it is a sample-to-sample comparison which also was listed above as a phase of reliability.

Validity is usually defined as including reliability, in the sense that if you are getting valid information, it must be that you are getting it reliably. But there is a sense in which validity does not include reliability. For instance, if it is desired to test for the information in a given textbook or set of books, then how representative the test is as a sample of that information is a question of validity. If the sampling procedure is good, the test is valid in the sense that we are getting the *kind* of information we want. The sample might, however, be too limited to provide ment, "Do not guess," offers a bonus to those who guess. Guessing includes all degrees of confidence from slightly less than certainty down to chance. In the long run, it will provide more correct than incorrect answers. The obedient students who, in accordance with instructions, do not guess, give up the possibility of adding a few more points to their scores. Those who ignore the instructions get the points and stand slightly higher in the class as a result. It would seem better either to use a penalty which would really deter or to instruct the examinees to answer all questions. If the latter procedure is followed, it is unnecessary to use the correction formula, for the students will be ranked in exactly the same order whether the scores are corrected or not.[13] The only reason for correcting the scores would be to keep the scores from looking like more knowledge than they really indicate. But this can be done by remembering that a score of 50 per cent of T is the zero for the test.

The Weighting of Part Scores

Often the examiner ends up with an examination made up of several rather distinct parts, perhaps some essay questions, some multiple-choice questions, and a true-false section. If the examiner has a definite idea concerning the importance of these sections, he may wish to control the influence which the several parts have upon the total score. The way to do this is to control the spread of the scores on the subtests, for when part scores are combined to form a total score they are influential in proportion to their spread or range. Suppose the essay scores for the group tested range from 1 to 10, the multiple-choice scores from 10 to 30, and the true-false scores ranged from 50 to 100. If combined just as they are, the multiple-choice scores would be twice as influential as the essay scores in determining the final rank of examinees, and the true-false part would be five times as influential. If the examiner wanted the essay, multiple-choice, and true-false sections of the examination to count in the ratio 3:2:1, he could accomplish his purpose by multiplying the essay scores by

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[13] The correlation between R and (R — W) is +1.00.

15, and the multiple-choice scores by 5. The same result could be accomplished with any weights with the same ratio, for instance, by using the multiple-choice scores at their present value, multiplying the essay scores by 3, and dividing the true-false scores by 5.

The Meaning of Scores

It is not wise to try to make a scoring scheme which will yield scores which look like percentage marks. An examiner who is experienced in his present position and experienced in the use of the various examination forms and materials may be able to plan such an outcome. A novice cannot expect the group to score according to his plan. Experienced or not, the examiner should not seek to relegate to a formula the placing of a value judgment upon a student's work. There are differences in examinations as to the extent to which they embody such a judgment. The things required in one examination may all be important outcomes. If they are, there is justification for saying in advance that to answer fewer than a given number is an unsatisfactory mark. But far more frequently, examinations are designed to be simply representative samples of the things taught. Such an examination should be looked upon as a tool for ranking the students according to their knowledge or skill in the area of the examination. Then the examiner can use all he knows about the students as a basis for converting scores into marks. When he has thus picked a passing point and decided how well pleased he is with the top-scoring pupils, he can prorate the scores into the marks conventionally used in his school.

Some teachers wish to be relieved of the necessity of making such judgments. They want a formula on the basis of which to assign the various marks to certain percentages of students. Some administrators require the same policy of all teachers to prevent some teachers from using their own judgment. Some who follow such a practice may think that it is demanded by statistics, but it is not. Statistics may be used, but statistics afford no basis for calling a student's work unsatisfactory. Hence, one should not think by studying statistics he can find which of the many variants of practice is the "correct" one. The practice is good for the user to the extent that it helps him do what he is trying to do. If you, as observer, disagree, your disagreement should rest upon your opinion that the practice does not help the user as he thinks it does, or upon the fact that you and he do not seek the same ends.

Much of the dissatisfaction with marks comes from the fact that marks are expected to serve so many different purposes. They are expected to contribute to the efficiency of learning and of teaching, to aid in school organization, to aid in the evaluation of the school system, to aid in the guidance program, to inform parents of pupil progress, aid schools to which pupils transfer or apply for admission, and to assist the employer in the selection of employees. In each school, achievement testing and marking practice should be justified either as that which is best designed to serve these several purposes, or as a necessary compromise.

Summary

The chapter was begun with the question, "Can we measure in education?" The answer given was "By 'absolute' standards, no!" Each question of an achievement test is itself a test, but the score is not in a strict sense a "measure." It is the number of item tests passed, i.e., questions answered correctly. Though we know that the answers to the several questions are not equal achievements, for practical purposes we assume that they are, and we use the scores as if they were measures of achievement.

The concentration and formalization of the testing function as it exists in measurement programs should not be thought of as entirely fulfilling the testing function. Testing must also remain an integral part of the teaching process. The measurement program should be thought of as supplementing, not as replacing, testing in teaching.

Another important caution concerning measurement programs is that they are likely to emphasize the *memoriter* intellectual achievements. Full evaluation in education needs to encompass all aspects of the developing personality with which the school needs to be concerned. All chapters of Part III together are needed for full consideration of this all-round evaluation. This chapter was confined to considerations which are pertinent to the area of the school's more traditionally defined responsibility.

Considerable emphasis was placed upon the concept of probable error because every user of the results of testing programs needs to be familiar with the concept, and needs to interpret scores, changes in scores, and differences between scores in the light of the probable errors involved. Everyone who gathers data for others to use should find out what the probable error is and report it. Suggestions were made for avoiding or minimizing error in test construction and in the interpretation of scores.

One of the most important things to realize in evaluation is that to seek "validity" is more important than to seek objectivity for the sake of "reliability." In and of itself, objectivity in a testing procedure is no guarantee that the procedure is good. The evaluator should first ask of a procedure whether or not it is well designed to give him the kind of information he needs for his purposes. When he is satisfied on that score, then he should get such data as objectively and reliably as possible. The same thing may be said of converting scores into marks. Objectivity is highly desirable, but the student should beware of making a fetish of it. Let the procedure be as valid as possible though it entails an undesirable degree of subjectivity in the evaluation.

CHAPTER X

MEASURES OF ABILITY TO LEARN

Teacher Judgments
Intelligence-Test Scores
Objective Achievement-Test Scores
Improvement in Score
Reliability
Probable Error
Other Limitations
Group Tests
Two Kinds of Derived Score
Summary

Teacher Judgments

In some respects the best measures of ability to learn are teacher judgments. If recorded at the end of the year in the lower grades, they are made on the basis of nearly 1000 hours of observation, and they cover a great variety of content area and of pupil interest. Average 6 such judgments and the measure is objective [1] as well as comprehensive.

The student went too far when, impressed by the unreliability and incomparability of grades, he said, "Grades don't mean a thing." Elementary-school grades correlate above .50 with secondary school grades.[2] Secondary-school marks correlate about .55 with college marks.[3] College marks in turn are some indication of future intellectual performance. Among those in the highest tenth according to marks, there were twice as many scientists starred in *American Men of Science* as among all the other nine-tenths put together. For the same groups the ratio of those elected to the National Academy of Sciences was three to one.[4]

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[1] Here "objective" is used to mean that practically the same result would be obtained by any 6 similar teachers. A test is an "objective" test because it makes relatively little difference who scores it. The results would agree. In other words, the process is an objective one to the extent that the result is the same regardless of who does whatever is involved in the process.

[2] *Encyclopedia of Educational Research*, Macmillan, 1941, p. 699.

[3] *Ibid.*, p. 848.

When Binet wanted to make a test to use in the Paris schools to help identify the pupils who were least capable of profiting from the instruction of the regular grades, he included teacher judgments among his criteria. In other words, he included or rejected test items, depending in part upon their agreement with teacher judgment. He wanted an instrument which would yield information approximating teacher judgment and at the same time achieve objectivity more economically.

Intelligence-Test Scores

Nearly all test makers have had in mind a similar use of intelligence tests in schools. And in educational circles, intelligence has come to mean "ability to learn." [5] Nearly all intelligence tests have been validated in part as to the extent to which they may be depended upon to predict school progress.

Usually school grades have been used as the criterion. By 1931 nearly 500 users of intelligence test scores as a basis for the prediction of college success had published their results.[6] The correlations [7] range from .00 to over .74. The central tendency was about .44.

Is .44 good prediction or poor? One way to answer the question is to look at the scattergram in Figure 3 in which the 271 entries show by their location both the intelligence score and the average college mark. That there is some tendency for high-scoring pupils to make high marks is apparent. But it is also apparent that large errors would be involved in predicting marks from scores. The coefficient of correlation of .55, mentioned earlier, is shown in Figure 4. The entries are closer to a diagonal from lower left to upper right, but still a large amount of error remains. It is unwise to set definite values for the coefficient of correlation below which prediction is "poor" and above which it is "good." Prediction does not suddenly cease to be poor and be-

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[4] Visher, S. S., *Scientists Starred 1903–1943 in American Men of Science*, Baltimore, Johns Hopkins Press, 1947.

[5] Pintner, R., *Intelligence Testing*, New York, Holt, 1931, p. 47.

[6] *Encyclopedia of Educational Research*, Macmillan, 1941, p. 846.

[7] *Ibid.*, p. 848, Table 4.

Intelligence Test Score	AVERAGE COLLEGE MARK										
	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99
85–89							1	2		1	
80–84					2	1		1	1		
75–79			1		1	2	2	6	1		2
70–74	1		1		1	2	6	3	3	1	1
65–69			1	3	4	4	7	8	6	1	
60–64				5	7	9	10	3	2	2	
55–59	1	2		6	8	7	4	5	3	1	
50–54	1		5	3	4	6	8	2	1	1	
45–49		4	4	3	7	8	3	2			
40–44	2	3	9	2	4	5	1	1		1	
35–39		1	3	4	1	3	2	1			
30–34			3	1		2	1	1			
25–29			2	1	1	1					
20–24							1				

Coefficient of correlation = .44

Fig. 3 The Correlation Between Intelligence Test Score and Average College Mark

Average Secondary School Mark	AVERAGE COLLEGE MARK										
	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99
98–99								2			1
96–97								1	1		
94–95									1	1	
92–93							1	1	1		
90–91			1		1	3	2	2	5	3	2
88–89				2	1	4	1	5	2	2	1
86–87				5	11	12	10	10	4	2	
84–85		2	2	2	4	10	15	6	2	1	
82–83	1	1	4	4	8	11	4	5	1	1	
80–81	2	1	4	7	7	3	5	2	2		
78–79		1	7	5	2	2	4	3	1		
76–77		2	1	2	3	1	2				
74–75	1		3	1	2	1					
72–73	1	1	2	2	1						
70–71		1		1		1					

Coefficient of Correlation = .55

Fig. 4 The Correlation Between Average Secondary School Mark and Average College Mark

come good at a certain value of "r" (coefficient of correlation). Predictive value is nil when r = .00, and it improves gradually as r rises from .00 to 1.00. However, it does not rise in direct proportion. One measure of goodness of prediction is how much the error of just guessing[8] is reduced by knowing the intelligence test score and the correlation. With Figure 5, the value of any r

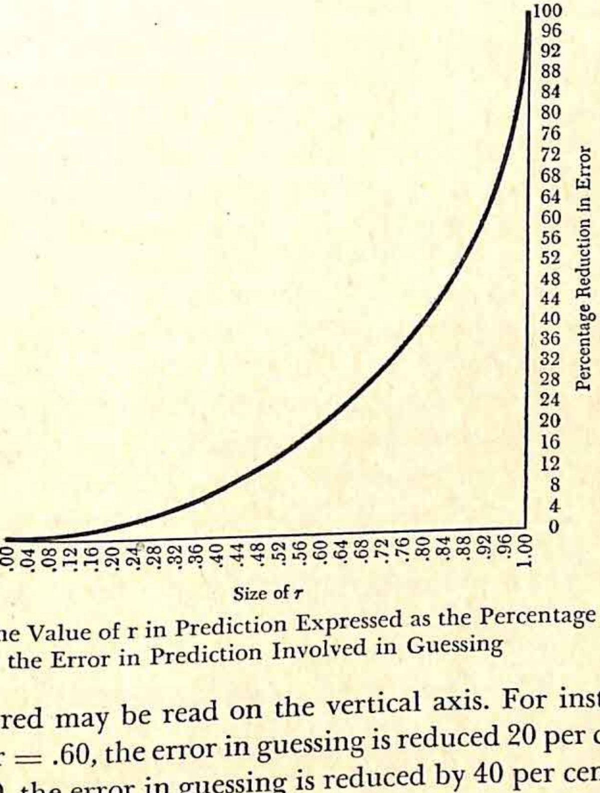

Fig. 5 The Value of r in Prediction Expressed as the Percentage by Which It Reduces the Error in Prediction Involved in Guessing

so measured may be read on the vertical axis. For instance, in using an r = .60, the error in guessing is reduced 20 per cent, and if r = .80, the error in guessing is reduced by 40 per cent.

Since, in practice, the r is seldom above .60, why is it that the intelligence test has not been discredited as a prediction of ability to learn? One reason is that ability to learn is thought to be only one of the several factors responsible for students' grades. Some of the other factors are home background, type of school previously attended, interest, and application. If these and other factors are influential, it is not reasonable to expect higher correlations between intelligence test scores and grades.

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[8] If just guessing, one would predict a C (i.e., average) grade for each student.

Objective Achievement-Test Scores

There is another reason why a correlation of .44 between intelligence test scores and grades is not thought of as discrediting intelligence test scores as measures of ability to learn. It is the tendency to mistrust grades as criterion measures.[9] The belief is that if objective achievement-test scores were used as the criterion of learning the correlation would be higher. Although the correlations are not invariably higher [10] they are higher in general.[11] A correlation of over .70 is to be expected between intelligence test scores and scores in achievement-test batteries.

Paradoxically, these higher correlations with objective test scores have caused more questioning of the concept of intelligence than has been caused by the lower correlations with grades.[12] People have been led to ask, "What is the difference between intelligence tests and achievement tests?" In considering intelligence-test scores as bases for predicting later learning, perhaps we are discussing how well general measures of past learning predict future learning. This interpretation of the intelligence test will be considered in chapter twelve where the concepts of native and acquired ability will be examined. Here it must suffice to note that as compared with achievement test scores as criteria, intelligence-test scores are good measures of ability to learn.

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[9] Crawford, A. B., and Burnham, P. S., *Forecasting College Achievement,* Part 1, New Haven, Conn., Yale University Press, 1946, pp. 132–133.

[10] *Encyclopedia of Educational Research,* Macmillan, 1941, p. 846.

[11] Kvaracena, W. C., and Lanigan, Mary A., "Pupil Performance on the Iowa Every-Pupil Tests of Basic Skills Administered at Half-Year Intervals in the Junior High School," *Educational and Psychological Measurement,* Spring, 1948, 8:93–100.

[12] Kelley, T. L., *Interpretation of Educational Measurements,* Yonkers, N.Y., World, 1927, pp. 62–65.

Improvement in Score

But suppose you take the position that there is only one valid measure of learning, namely, improvement in score, or gain.[13] Then substitutes or indexes must be validated by their ability to agree with or predict such measured gains.

There has not been much tendency to require such validation. In fact, in educational practice, very little use is made of such measured gains. The almost universal tendency is to grade and appraise in terms of status at the end of periods of instruction. Research workers measure before and after for experimental purposes, and if matched groups are involved they usually match in part on the basis of intelligence-test scores and initial test scores, but they seldom report how necessary it is to take such precautions. That is, they seldom report the correlations between the intelligence-test scores and the gains, or between the initial test scores and the gains.

The central tendency of such correlations as have been reported is very low. Because of this fact some writers have cautiously stated that the relation between intelligence and ability to learn is uncertain.[14] Others have accepted the negligible relationship reported as invalidating the use of intelligence-test scores as indexes of ability to learn.[15] Of these two positions, the former is the more tenable. The measures of learning which have been used are of very uncertain merit as criteria for the purpose. To constitute satisfactory criteria (1) they need to be reliable (two such sets of measures should agree), (2) they should be obtained in a situation in which each learner is afforded the opportunity to learn according to his ability, and (3) they should come from the use of tests which adequately sample the learning.[16] The measured gains used have not been selected because of their fitness as criteria. They have not even been described as to such fitness.

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[13] Woodrow, H., "The Ability to Learn," *Psychological Review*, 1946, 53:147–148.

[14] Thorndike, E. L., Bregman, E. O., Tilton, J. W., and Woodyard, Ella, *Adult Learning*, New York, Macmillan, 1928, p. 258.
Mursell, J. L., *Psychological Testing*, New York, Longmans, Green, 1947, p. 129.

[15] Woodrow, H., *op. cit.*
Simral, Dorothy, "Intelligence and the Ability to Learn," *Journal of Psychology*, 1947, 23:27–43.

Gains of low reliability are even less suitable as criteria when it is desired to compare initial scores with them. The errors which make the initial scores higher than they should be make the gains lower, and vice versa. The result is a tendency toward negative correlation between initial scores and gains,[17] which must be eliminated or corrected for, before any conclusion is drawn about the comparability of initial scores and improvement of scores. Probably the frequency with which the reported correlations between initial scores and gains are negative [18] is a reflection of the low reliability of gains as they are usually measured.

Until correlations have been computed in many cases in which good criterion measures of learning are used, perhaps one should say that the relation between either intelligence-test or initial scores and measured ability to learn is an open question. But if a tentative position is to be taken on the basis of the facts now available, the satisfactory correlation with measures of what has been learned deserves much greater weight than the negligible correlation with gains. Achievement-test scores are measures of learning over a long period and under a great variety of circumstances. Gains are measures of learning over much shorter periods, and under more specific restrictions. It is not reasonable to expect the prediction of gains to be as generally satisfactory as is the prediction of status scores in the same areas of school learning. In other words, although some interpret the facts as an invalidation, and some find them simply insufficient, the great body of school practice is justified, as the writer sees it, in that it accepts measures of what we know and can do as our best measures of ability to learn.

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[16] Tilton, J. W., "Intelligence Test Scores as Indicative of Ability to Learn," *Educational and Psychological Measurement*, Autumn, 1949, Vol. 9, pp. 291–296.

[17] Zieve, L., "Note on the Correlation of Initial Scores with Gains," *Journal of Educational Psychology*, May, 1940, 31:391–394.

[18] Rosther, L. E., "The Measurement of Teaching Ability, I," *Journal of Experimental Education*, September, 1945, 14:6–51.
Rolfe, J. F., "The Measurement of Teaching Ability, II," *Journal of Experimental Education*, September, 1945, 14:52–74.
LaDuke, C. V., "The Measurement of Teaching Ability, III," *Journal of Experimental Education*, September, 1945, 14:75–100.
Jones, R. D., "The Prediction of Teaching Efficiency," *Journal of Experimental Education*, 1946, 15:85–89.

Reliability

Whatever measure of ability to learn is used, its reliability should be known by every user. If it is teacher judgment, it should be known how well one teacher's judgment agrees with another's, or how well the average of two such judgments agrees with the average of two others, or three with three, etc., until a satisfactory degree of objectivity is achieved. As pointed out in chapter nine, any objective test can be divided into two tests, made up, for instance, of the odd-numbered items and even-numbered items. Then the two sets of scores can be compared for a measure of agreement. When, as is the case for most standardized tests, two or more forms are available, the scores on two forms are compared.[19]

It has been customary to express this comparison as the coefficient of correlation between the two sets of measures. But a coefficient of correlation is not the measure of reliability with the most definite meaning because *the size of coefficients of correlation depends upon the range of ability within the group measured as well as upon the instrument used.* This is a truth about correlation of such general usefulness as to be worthy of the emphasis which an illustration will provide.

Consider the coefficient of correlation between height and reading ability. Assume it to be zero in a third grade. Assume it to be zero also in the other grades in the same school, the fourth, fifth, sixth, seventh, and eighth. What is the coefficient of correlation between height and reading ability in the school? Hypothetical data are presented in Figure 6. In Figure 6-A are entered the facts for the third grade, the taller pupils being neither higher nor lower in reading ability than the shorter ones. But in each succeeding grade the group in general will be taller and also will be better readers. In other words, the data for a combination of Grades III to VIII will fall in different squares as shown in Figure 6-B though uncorrelated within a single grade. The result is a correlation of +.91 between height and reading ability within the school. Hence it is not enough to be told what the r is between height and reading ability; one needs to know the age and grade range of the group for which the r is reported. There is no general answer to the question, "What is the correlation between x and

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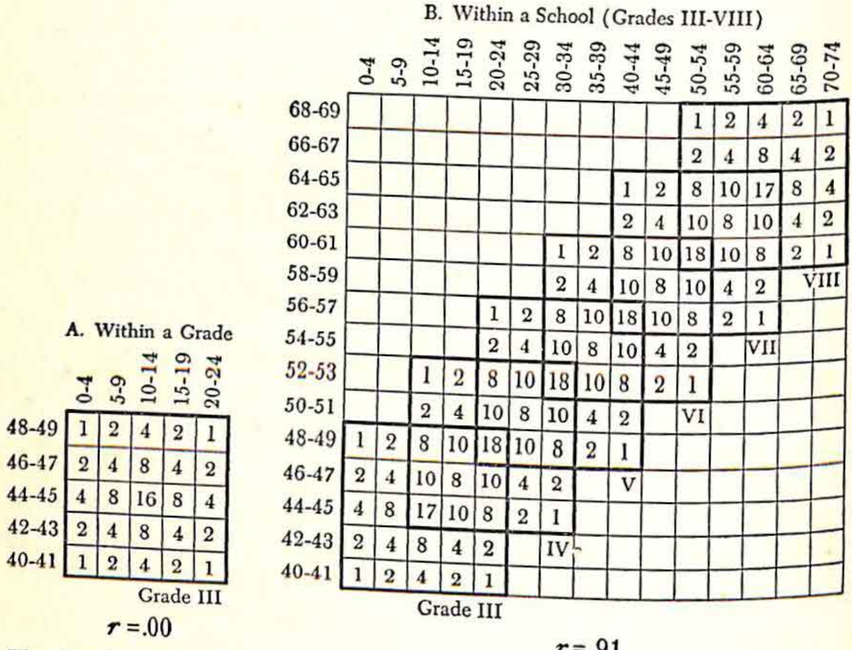
[19] The terms "reliability" and "validity" were defined in Chap. IX. It was pointed out there that validity is most often defined as inhering in a test. "Does the test measure what it purports to measure?" But validity depends upon the user's needs. It is therefore better defined as the extent to which a method gives the user the kind of information he wants. Questions of reliability are questions of inner consistency, i.e., agreement between parts of the data when the parts, so far as is known, differ chiefly by chance. Objectivity as defined earlier is a phase of reliability. It embraces those questions of disagreement due to different persons being involved, different raters, different scorers, etc.



A. Within a Grade

	0-4	5-9	10-14	15-19	20-24
48-49	1	2	4	2	1
46-47	2	4	8	4	2
44-45	4	8	16	8	4
42-43	2	4	8	4	2
40-41	1	2	4	2	1

Grade III

$r = .00$

B. Within a School (Grades III-VIII)

	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
68-69											1	2	4	2	1
66-67											2	4	8	4	2
64-65									1	2	8	10	17	8	4
62-63									2	4	10	8	10	4	2
60-61							1	2	8	10	18	10	8	2	1
58-59							2	4	10	8	10	4	2		VIII
56-57					1	2	8	10	18	10	8	2	1		
54-55					2	4	10	8	10	4	2		VII		
52-53			1	2	8	10	18	10	8	2	1				
50-51			2	4	10	8	10	4	2		VI				
48-49	1	2	8	10	18	10	8	2	1						
46-47	2	4	10	8	10	4	2		V						
44-45	4	8	17	10	8	2	1								
42-43	2	4	8	4	2		IV								
40-41	1	2	4	2	1										

Grade III

$r = .91$

Fig. 6 Correlation Between Height and Reading Ability (Hypothetical Measures)

y?" The r between the same kinds of scores is different for different groups.

Probable Error

Since the coefficient of correlation as a measure of reliability is ambiguous without a description of the group tested, a better measure is the probable error of a score. The term "probable error" was illustrated in chapter nine with reference to achievement-test scores. It is of such importance that it is illustrated again with intelligence-test scores. Suppose a child were given a Stanford-Binet test 21 times, and that the resulting I.Q.'s were 106, 114, 108, 115, 120, 118, 119, 113, 115, 111, 117, 108, 110, 112, 112, 113, 117, 108, 118, 123, and 121.[20] The average of these measures, 114, is called the true I.Q. for lack of better information. The errors are then 8, 0, 6, 1, etc. They range from 0 to 9. The median of the 21 errors is 3.7. Such a measure is known as the probable error.

In physical measurement it is customarily found in this manner, by making many measurements, considering the average value as the true value, noting the error in each measurement, and taking the median of these errors. But *people* cannot ordinarily be measured many times without the introduction of changes which would complicate the determination of error. Fortunately, statisticians have described a substitute method. Instead of measuring one person many times, the substitute method calls for the measurement of many people twice. The median of the discrepancies is only slightly larger than the probable error, and bears a constant ratio to it, namely 1.4 (more precisely $\sqrt{2}$). In other words, .7 of the median discrepancy gives a good estimate of the probable error which would have been obtained by the method described above. The substitute method may be illustrated with I.Q. data. In the following table are listed the discrepancies between I.Q.'s on successive testing for 757 children.[21] The median discrepancy is 4.25 points, seven-tenths of which gives a probable error of 3.0 points.

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[20] These I.Q.'s were actually obtained for the same child, but the fluctuations may be greater than may be attributed to errors in measurement because the testing was distributed over a ten-year period from age 3 to age 13. Wallin, J. E., "The Results of Multiple Binet Retestings of the Same Subjects," *Journal of Genetic Psychology*, 1940, 57:345–391.

Discrepancies in I.Q. Between a First and a Second Stanford-Binet Testing

DISCREPANCIES	FREQUENCIES
More than 20 points	9
20 points	2
19	1
18	4
17	7
16	7
15	6
14	11
13	12
12	14
11	18
10	16
9	30
8	40
7	71
6	59
5	52
4	77
3	91
2	70
1	103
0	57
	757

This is also the probable error for the Terman-Merrill revision when used to determine the I.Q. of children of average brightness. But the P.E. varies according to the I.Q. of the child being tested. The Terman and Merrill data indicate probable errors as follows:[22]

I.Q.	*P.E.*
130–	3.5
110–129	3.3
90–109	3.0
70– 89	2.5
– 69	1.5

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[21] Taken from Table 17, p. 103, Irwin, Elizabeth A., and Marks, L. A., *Fitting the School to the Child*, New York, Macmillan, 1926.

[22] Terman, L. M., and Merrill, Maud, *Measuring Intelligence*, Boston, Houghton Mifflin, 1937, p. 46.

Everyone in education should require and use information of this sort concerning error. It would keep people from attributing undue precision to the results of testing. When considering a child's I.Q. they would be reminded that the reported I.Q. is just as likely to be in error by more than 3 points as it is by less than 3 points.[23] And since the distribution of errors is always skewed away from the zero end as in Figure 7, those who are familiar with the curve shown there are reminded that the error is occasionally more than four times the probable error. Figure 7 shows that in 100 measurements, 50 of the errors may be expected to be less than 1 P.E., 32 between 1 and 2 P.E., 13 between 2 and 3 P.E., 4 between 3 and 4 P.E., and 1 larger than 4 P.E. This means for a reported I.Q. of 88, first, that it is only a 50-50 chance that the "true" I.Q. is between 85 and 91; and second, that there is a small chance (less than 1 in 100) that the "true" I.Q. may be as low as 76, and the same chance that it may be as high as 100.

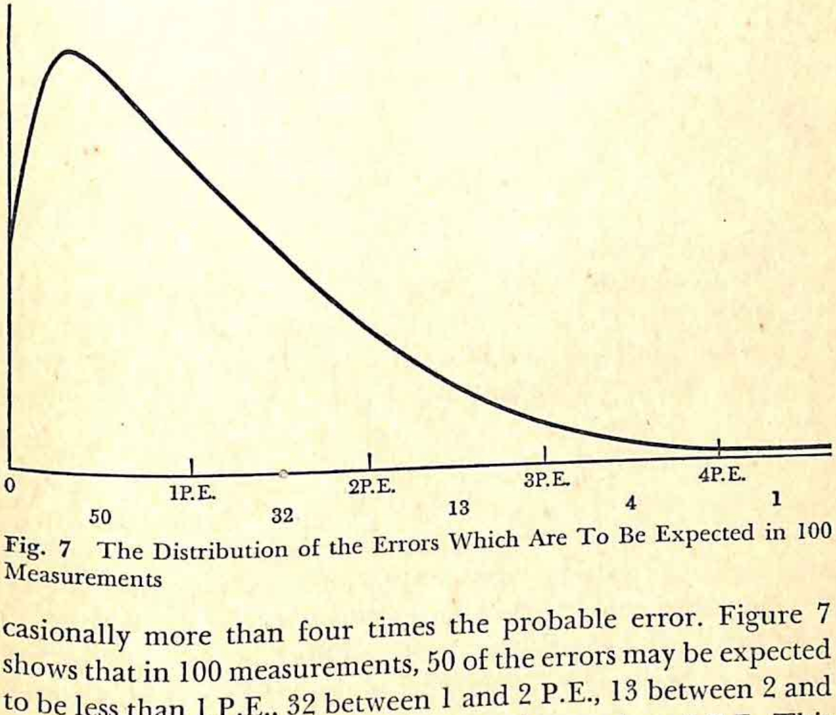

Fig. 7 The Distribution of the Errors Which Are To Be Expected in 100 Measurements

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[23] The probable error is the median error, and a median separates the lower half of cases from the upper half.

Other Limitations

Occasionally a child is in no mood to coöperate to the extent required for valid measurement by a test like the Binet. I.Q.'s obtained under such circumstances and again under more favorable circumstances have been reported as follows: 79 and 97, 79 and 99, 70 and 105, 87 and 113, 84 and 99, and 78 and 100.[24] Obviously good clinical judgment is required in order to know when rapport is adequate.

Probably trained examiners vary as to their suitability for such work. At any rate, they vary. Of 25 examiners,[25] the one whose findings tended to be highest reported I.Q.'s which averaged 8 points higher than the average examiner reported for the same children. The one whose findings averaged lowest reported I.Q.'s which averaged 6 points below those found for the same child by average examiners.

There is always the risk in presenting such facts, that the reader will conclude that intelligence-test results, as the student said for grades, "Don't mean a thing." There are always some who have too much confidence in intelligence testing, and there are some at the other extreme who have none.

Group Tests

Since individual testing requires so much time of a trained examiner, it is fortunate that group tests yield scores which are such good substitutes. It is quite possible that the group-test scores may be of equal or greater validity for some pupils and for certain purposes. If one wants to know a pupil's ability to perform in a group situation, it is better to measure his performance in a group situation.

Although there is no reason why the group test could not be made so as to be as reliable as the individual test, there are some data [26] which indicate group-score probable errors of 3.9 I.Q. points. This is 30 per cent larger than the probable error reported above for the Stanford-Binet I.Q.

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[24] Blanchard, Phyliss, "The Interpretation of Psychological Tests in Clinical Work with Children," *Mental Hygiene*, 25:58–75.

[25] Cattell, Psyche, "Stanford-Binet I.Q. Variations," *School and Society*, 45:615–618.

Two Kinds of Derived Score

Perhaps this section should be entitled "two *other* kinds of derived score" for the I.Q. is a derived score. The I.Q. is the ratio of a child's development to average development, in other words, his rate of development in comparison to 100, the rate by definition for the average child. But there are two other ways of describing a child's score with which everyone in education should be familiar: the centile or percentile, and the standard, or "T score."

It is customary to say that the centile score describes by telling how a person would rank among 100. But strictly speaking, the centiles are the 99 scores, or hypothetical scores, which separate the lowest 1 from the other 99, the lowest 2 from the other 98, and so on to the point separating the highest 1 from the 99 below. The points separating the 10 from the 90, the 20 from the 80, etc., are the 9 decile points. The 3 points separating the lowest 25 from the upper 75, the lower 50 from the upper 50, and the lowest 75 from the upper 25 are called quartiles.[27] The middle quartile which separates the lower 50 per cent from the upper 50 per cent is also called the median. All these scores are separation points. The 99 centiles separate the group into 100 equal subgroups, the 9 deciles separate it into 10 equal subgroups, and the 3 quartiles separate the group into 4 equal subgroups. For many standardized tests these separation points are given for the group upon whom the test was standardized. Then when someone uses the test, he can compare a pupil's score or a group's average score with the scores of the standardization group. He knows how many of them made lower and higher scores. If the pupil's score, according to the *Test Manual,* is equivalent to the 30th centile, 30 per cent of the standardization group made lower scores, the other 70 per cent made higher scores.

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[26] Miller, W. S., "Variation of I.Q.'s Obtained from Group Tests," *Journal of Educational Psychology*, 1933, 24:468–474.

[27] Incorrectly, but quite commonly, the 4 quarters of the group are called quartiles, as when a student is said to be in the highest quartile.

The standard score is designed to give similar but not exactly the same information. The centile scores are separation scores, located by counting cases. Standard scores are located instead by the size of the scores. First the scores are averaged. Then the spread of the scores around the average is measured in a manner which seems unduly laborious to those without statistical training. This measure of spread is called the standard deviation. For each score, a deviation from the average is recorded. Each of these deviations is squared. Then those squared deviations are averaged. The square root of the average squared deviation is the standard deviation, often referred to as sigma, and as the root-mean-square deviation, because these words in reverse describe its computation.[28] With sigma computed, all scores are rewritten as deviations from the average in multiples of sigma. But this gives plus and minus scores, which are awkward. McCall [29] suggested rewriting the scores again as if the average were 50 and the sigma were 10. The suggestion has proved to be a useful one, though often 500 is used as the mean and 100 as sigma.

These standard (sigma, or T) scores, especially when based on 50 as a mean, look like centile scores, which is unfortunate. And since more, rather than less use of the standard score is to be expected, all users of quantitative information about pupils should know that centiles and standard scores differ not only in the method by which they are determined but in the information which they convey.

This latter difference is illustrated in Figure 8, for a normal distribution of scores. The 10th, 20th, 30th . . . 90th centiles are located above the base line. The 10th, 20th 30th . . . 90th standard score locations are noted below the base line. Below the line the distribution of 1000 cases is shown with reference to the 9 standard scores.[30] The distribution of cases with reference to the 9 centile scores is not shown in the figure, because, as pointed out above, by definition or method of determination, these 9 points divide the group into tenths.

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[28] Why go to all this trouble? For practical purposes there is no good reason. But when computed, it is so much more usable mathematically than any other measure of spread that those with only slight training in statistics find the extra work justified.

[29] McCall, William, *How to Measure,* New York, Macmillan, 1922. It was McCall who suggested that such derived scores be called T scores.

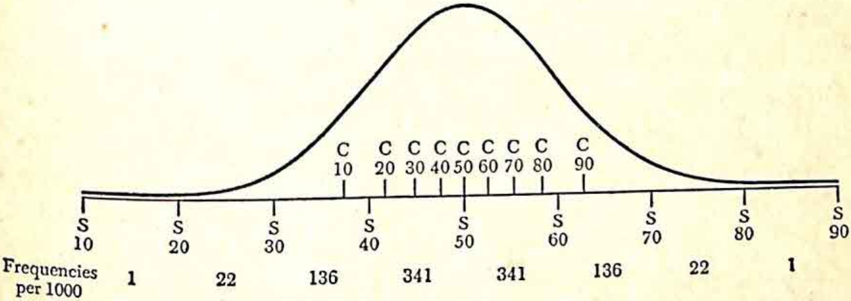

Fig. 8 The Difference in Significance Between Centile and Standard Scores

We may now note the differences. Not 1 person in 1000 scores above a standard score of 90, but 100 score above the 90th centile, etc. Suppose it is reported that a student made a score of 700 on an examination, for instance, the Graduate Record Examination. If one does not know about standard scores, he assumes that the score is a centile carried out to one decimal place. It is therefore further assumed that the score is above average but surpassed by 30 per cent of graduate students. But since the Graduate Record Examination scores are standard scores, the 700 informs instead that the score is one which is surpassed by only 23 in 1000. The only point at which these two kinds of derived score (centile and standard) have the same significance is at the center, where the 50th centile and a standard score of 50 (or 500) divide a normally distributed population into halves.

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[30] This distribution is attainable from tables in textbooks on statistics, because a normal curve is not only a symmetrical curve but one with specific mathematically defined relationships to the x and y axes.

Summary

Teacher judgments, if based on comprehensive observation, and objectified by pooling, are good criteria of a pupil's ability to learn. Increases in scores (i.e., gains) over short periods are not a good substitute. Often, if not usually, they are not a dependable basis for ranking pupils as to their ability to learn.

Scores on objective intelligence and achievement tests which sample all that pupils have learned up to that time in areas of scholastic importance are satisfactory substitutes for comprehensive and objective observation, and they are at the same time economically obtainable.

In educational practice, the pupil's ability to learn is most frequently described by comparing his intelligence-test score with the average score of his age group. This ratio, or rate of development, is usually called the I.Q. If obtained from group tests, the indications are that the probable error of measurement is between 3.5 and 4 points. Obtained by a trained examiner using a Binet test, the probable error is just about 3 points.

Many test scores from which an I.Q. cannot be computed may still be used as an index of ability to learn. In such a case, the pupil is usually compared with pupils in general by one or the other of two methods. His score is located among the various centile scores for the standardization group, or it is described as equal to a certain standard score for that group.

Note that whether the pupil's ability to learn is described with an I.Q., a centile score, or a standard score, he is being described by comparing him with some reference group. Most of what is called measurement in education rests upon such comparison. In fact, much description which is usually thought of as clinical or qualitative is meaningless without reference to an assumed background knowledge of individual differences. This dependence will be more apparent in the following chapter for we shall be entirely dependent upon a foundation of individual difference in answering the question, "How specialized is ability to learn?"

CHAPTER XI

SPECIALIZATION OF ABILITY TO LEARN

The Obviousness of Specialization
The Purpose of This Chapter
Dependence upon Group Reference
Methodological Definition of Specialization
How Specialized Is Scholastic Ability?
Specialization When Intelligence Tests Are Used
Specialization among Measures of Learning
Dependence upon the Group Reference
Specialization as Shown by Factor Analysis
The Concept of Special Ability
Summary

The Obviousness of Specialization

Specialization of ability is so obvious that it was noted long before the use of objective measurement. According to Quintilian,[1] the good teachers of his day (c. 35–96) made it their business to know the pattern of abilities which characterized each of their pupils so that they might adapt their teaching to that pattern.

Early in the history of modern psychology, cases of extreme specialization were described. Among Scripture's [2] cases were the following:

> Jeremiah Buxton, born in England in 1702, could not write his name. Outside of mental arithmetic, he was not considered the equal of a boy of 10. He was not rapid but he could make such mental computations as are required to give the cubical eighths of an inch in a volume described in yards as 23,145,789 by 5,642,732 by 54,965.

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[1] Butler, H. E., *The Institutio Oratoria of Quintilian, with an English Translation,* London, Heinemann, and New York, Putnam, 1921–1922. See Vol. 1, Book II, Chap. VIII, sec. 1.

[2] Scripture, E. W., "Arithmetical Prodigies," *American Journal of Psychology,* April, 1891, 4:1–59.

Thomas Fuller, a Negro slave in Virginia, born in 1710, did not know how to read or write. Asked how many seconds in 70 years, 17 days and 12 hours, he answered correctly in a minute and a half.

Zacharias Dase was born in Germany in 1824. He exhibited his calculating ability before a number of able mathematicians in Germany and in England. They gave him up as stupid after one had tried for 6 weeks to tutor him in mathematics. He could not master a proposition in Euclid, but he could mentally multiply 79,532,853 by 93,758,479 in 54 seconds.

Henri Mondeux was born in France in 1826, the son of a woodcutter. The boy was unschooled, a tender of sheep from the age of 7. A schoolmaster heard of his calculating ability, looked him up, and found that he could not read, write, nor do arithmetic on paper. The schoolmaster presented Mondeux, at the age of 14, to the Academy of Sciences at Paris. He could solve a problem like this in a few seconds:

> From a fountain each person took the same amount of water.
> A drew 100 quarts and 1/13 of the remainder;
> B drew 200 quarts and 1/13 of the remainder;
> C drew 300 quarts and 1/13 of the remainder;
> etc., until the fountain was empty.
> How many quarts were in the fountain before any water was taken out?

"In other matters Mondeux showed only mediocre intelligence" and failed to develop as his sponsors had hoped.

Similar cases of specialization along other lines have been described.[3] Contrasted with such cases in which the person's ability in some one area is far superior to his general level of ability are the cases of special disability. Here the picture is reversed. Ability in some one area is far below the person's general level of ability. Fernald,[4] for instance, described the case of a young man 17½ years old who had a Stanford-Binet mental age of 16 years 8 months, yet had a "complete inability to read, in spite of steady attendance at good schools."

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[3] Hollingworth, L. S., *The Psychology of Subnormal Children*, New York, Macmillan, 1921, pp. 128–129.

Hollingworth, L. S., *Special Talents and Defects*, New York, Macmillan, 1925, pp. 154–161.

[4] Fernald, Grace, *Remedial Techniques in Basic School Subjects*, New York, McGraw-Hill, 1943, pp. 130, 287–293.

The Purpose of This Chapter

These are unusual cases of specialized ability and disability. Far more common are the cases which show a noticeable though not spectacular disparity between ability in certain areas and the general level of ability. These cases are so common, and the differential though not spectacular is still so obvious that there is no point in asking whether there is specialization of ability. The questions which need to be asked are: "To what *extent* is ability specialized?," and "In what areas is specialization most common or most pronounced?" These are the questions for this chapter. In considering them, some comment must be made upon factors responsible for patterns of ability. But the heredity versus environment aspect of the problem is postponed for consideration in the following chapter. In the present chapter, abilities are considered as they are found and measured without regard to the question of capacity or potentiality.

Dependence upon Group Reference

Throughout this chapter it is important to keep in mind that the individual is described with reference to a group.[5] The profiles of school abilities with which teachers are most familiar describe the pupil with reference to the group upon which the tests were standardized. The profile would have a different shape if the tests were not standardized and the pupil were compared with all pupils in his grade in the local system. It would have still a third pattern if he were compared with his own class.

Without such a group reference, a profile would have no practical significance. The number of questions answered in the reading test, the number of problems solved on the arithmetic test, the number of words spelled correctly, etc., have no commensurability except in terms of some group's performance. In brief, all observations concerning specialization rest upon a foundation of information about the individual differences within a reference group. This will be apparent as the needed concepts of general and specialized ability are defined methodologically in the following section.

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[5] See Chap. X.

Methodological Definition of Specialization

The simplest and most straightforward approach to the question of extent of specialization is to ask how much unevenness there is in profiles of ability. This approach is the simplest because the concepts needed may be illustrated. Suppose we have tested the pupils of a certain sixth grade with an achievement-test booklet made up of five tests. The parts of the test might be reading, arithmetic, spelling, language, and social studies. With such test results we might answer the question, "How much unevenness is there in the profiles of the sixth-grade pupils?" To represent the situation graphically in Figure 9, individual differences in the five areas are arbitrarily assumed to be equal, in each case ranging from a T score of 20 to one of 80. This is equivalent to saying, "Let us omit from consideration the profile of the tested group as compared to another reference group such as exists in the standardization group for standardized tests." The five distributions are made alike by (1) considering as equal the group's average scores in reading, arithmetic, spelling, language, and social studies; and (2) assuming that the group's spread within the five areas is the same.

Within these five distributions representing the equal scaling of the group's five abilities, let the crosses on the base lines indicate the scores made by a pupil A, who made relatively low scores. The average of A's five scores places him as shown by the dotted line. The dotted line, in other words, is his average position. In reading, he is 7 points below his average score; in arithmetic 3 points below. The high points of his profile are spelling and social studies. Here A's profile is shown against a background of individual differences, i.e., in reference to his sixth-grade group. Profiles should always be seen, in imagination if not in actuality, against such a background. For the same profile would appear very uneven or specialized against a narrow range of

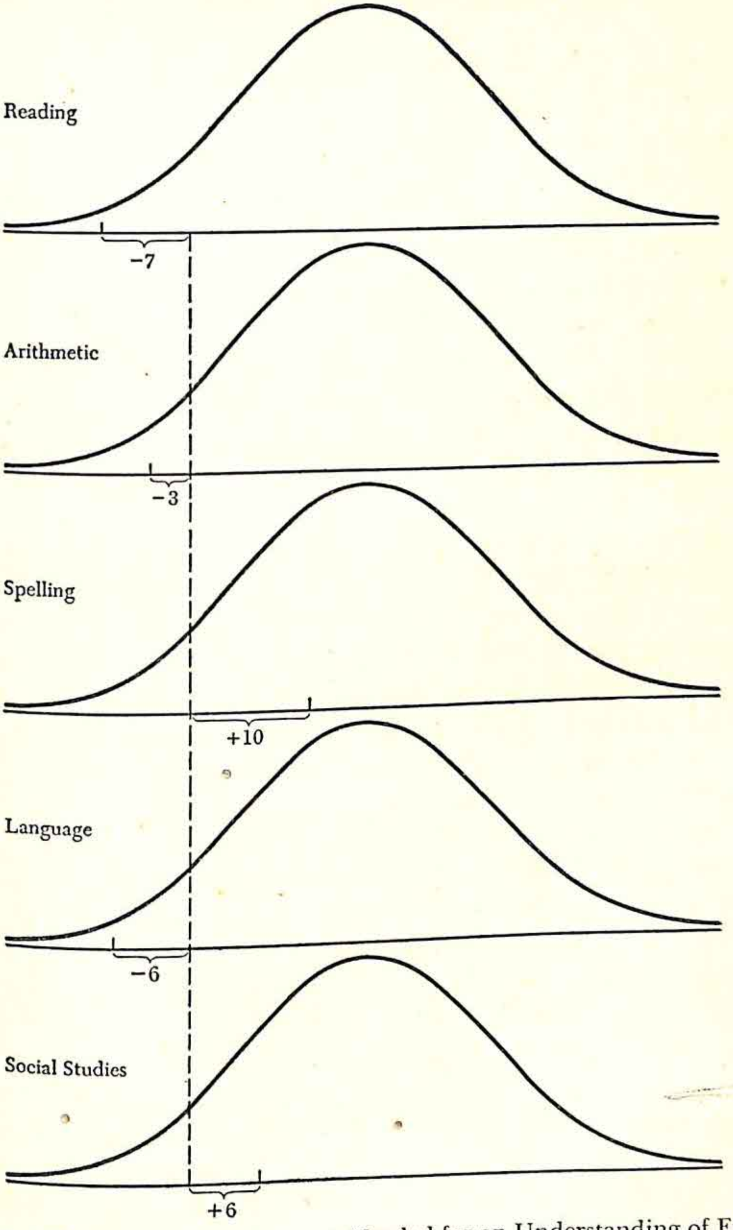

Fig. 9 Illustration of the Concepts Needed for an Understanding of Fig. 10

individual differences, but very even or generalized against a wide range.

Now suppose the scores for each pupil in the grade were available. Corresponding to A's -7, -3, $+10$, -6, and $+6$, there would be five unevenness (profile or specialization) scores for each pupil. By throwing them all together, one could make a curve of distribution for unevenness scores and could make a generalization about the specialization of abilities for this grade group. Would the resulting curve of distribution have as wide a range as do the curves in Figure 9? It could, only if all pupils had the same average score, which is not likely in any grade group. The more widespread the average scores for the group, the narrower the spread of the unevenness scores, and vice versa. And what about the distribution of average scores? No one would be expected to have an average score of 20 at the extreme left, nor one of 80 at the extreme right because, although abilities are positively correlated, the r is not $+1.00$.

There is a mathematical relationship between the spread of unevenness scores, the spread of average scores, and the spread of the scores averaged. For those with statistical training, the relationship is simply described as such that the variance (the standard deviation squared) of the first plus the variance of the second equals the variance of the third. In other words, the variance of the measures averaged is divisible into two parts, that in the average scores and that within the profiles. The same relation does not hold for the three standard deviations, nor for such measures of spread as the mean deviation and the range. However, the range, as the length of the base line under the curve, has a more graphic meaning. With it we may compare the amount of specialization with the spread of generalized ability, and both with the spread of the single abilities averaged. Even though the lengths of the three base lines (for unevenness scores, average scores, and single ability scores) are not related as are the variances, it is still true that were there no spread within the profile (i.e., no unevenness) the generalized ability line would be as long as the single ability lines. And in reverse, were there no individual differences in general (i.e., average) ability, the specialization base line would equal the single ability lines.

These extreme cases define a scale upon which a given set of facts may be described. At one end, the maximum of generalization (maximum spread of average scores) and no specialization, i.e., no unevenness of profiles; at the other end, the maximum of specialization (maximum unevenness of profiles) and no differences in average score, i.e., no spread of general ability. Since the extremes are not found in practice, for any particular set of data the ratio of the specialization or S line to the generalized ability or G line will serve as a practical measure of the extent to which ability in the area of the measures is specialized. If the S line is longer than the G line, i.e., if there is more unevenness in profiles than there is spread of average scores, then in that situation abilities are more specialized than general. If, on the other hand, the G line is the longer, then ability in the area measured may be said to be more general than specialized.

How Specialized Is Scholastic Ability?

Kelley [6] reported Stanford Achievement Test data for pupils 11 years old on their previous birthday, and also for pupils 14 years old on their previous birthday, and who in all cases had made normal progress for their age. For the first group the S line was only 79 per cent of the G line; for the second group it was 83 per cent. The abilities were paragraph meaning, sentence meaning, word meaning, arithmetic computation, arithmetic reasoning, science, language usage, and spelling.[7]

Woodrow [8] reported Metropolitan Achievement Test data for all the pupils in a single community who were in grade four, all in grade five, and all in grade six, and in each case for the same pupils a year later when they were in grades five, six, and seven.

[6] Kelley, T. L., *The Influence of Nurture Upon Native Differences*, New York, Macmillan, 1926, pp. 48–49.

[7] A ninth measure, history and literature, was discarded for this report because the two subjects were combined.

[8] Woodrow, H., "Intelligence and Improvement in School Subjects," *Journal of Educational Psychology*, 1945, 36:155–166, Table 1, p. 156.

The abilities measured were reading, vocabulary, arithmetic fundamentals, arithmetic problems, English, and spelling. The ratio of S line to G line for these six sets of data were .93, .72, .89, .77, .75, and .89 respectively.

The general tendency of these data is shown in Figure 10. The amount of specialization or profile unevenness is shown at the top. Below it, under the middle frequency curve, is the spread of general or average ability in the grade. At the bottom of the figure is the spread in the grade for one of the abilities averaged.[9] The base line for the bottom curve corresponds to the base line of any one of the five curves in Figure 9, except that the units in Figure 10 are grade-location scores instead of T scores.

Here in Figure 10 are the facts of individual and trait differences with which the teacher is confronted. Only 25 per cent of his class are "at grade" for any one of the subject areas measured, if "at grade" is defined as within the limits of one-half grade below and one-half grade above. About 21 per cent are within similar limits for the grade above, and a like per cent are within similar limits for the grade below. Seventeen per cent qualify for a still higher grade, and at the other end of the distribution, 17 per cent fall below the strict definition of the next lower grade.

In average ability they are a less heterogeneous group, but still far from homogeneous. Thirty-two per cent, as compared with 25 per cent, are within the precisely defined grade limits. Only 22 per cent, as compared with 34 per cent, are graded 2 or more grades above or below their measured ability.

At the top of Figure 10 are the facts concerning specialization. It is shown there that in general 39 per cent of the points in an achievement-test battery profile may be expected to be within a half grade of the pupil's average grade-equivalent score. For the

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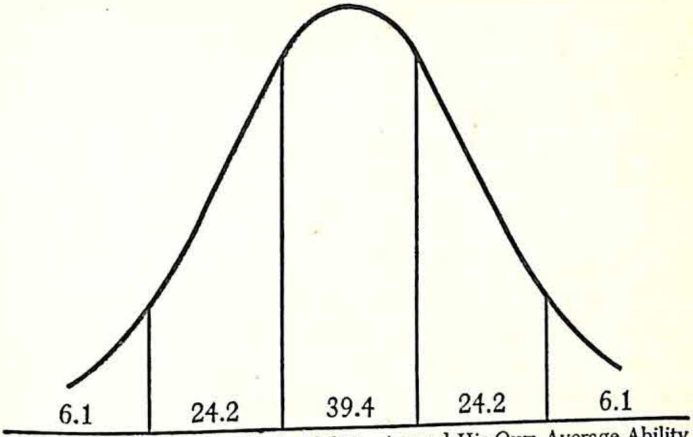
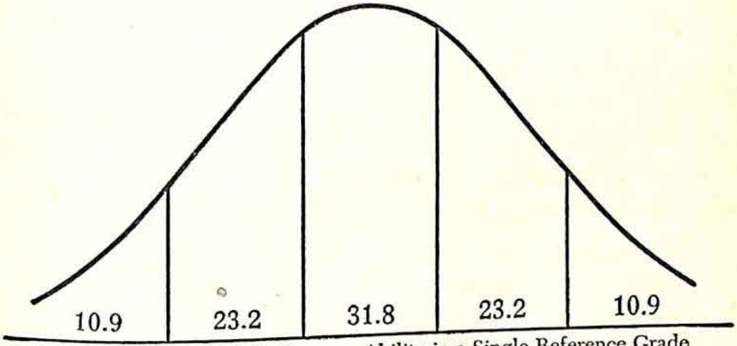
[9] The percentages are normal probability integrations. One grade equals .64 based upon the fact that grade 8.0 — 7.0 by the "advanced" tests and 6.0 — 5.0 by the "intermediate" tests averaged .64 S.D. on a single test.

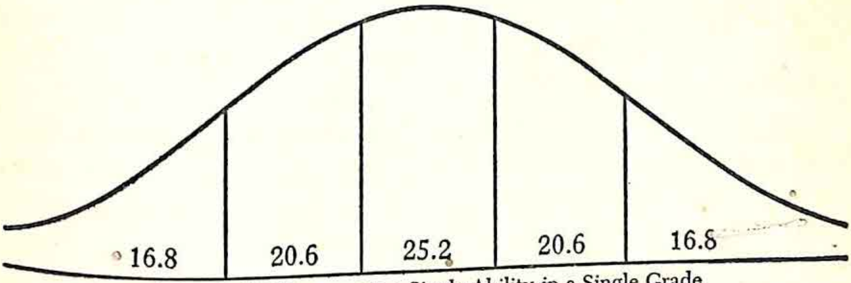
Metropolitan Achievement Tests: Manual for Interpreting, Yonkers, N.Y. World, 1948, and for the same tests, *Key and Directions for Scoring Intermediate Form R and Advanced Form R.*



Distribution of an Individual's Abilities Around His Own Average Ability



Individual Differences in Average Ability in a Single Reference Grade



Individual Differences in a Single Ability in a Single Grade

Fig. 10 The Specialization of Scholastic Ability as Measured by One Achievement Test Battery (Frequencies Are Percentages)

32 per cent referred to in the distribution of average abilities as "at grade," this is equivalent to saying that they are "at grade" for fewer than half their subjects. Six per cent of the points in their profiles are appropriate for 2 or more grades higher, and 6 per cent for 2 or more grades lower. The same facts mean, for the 11 per cent of pupils who are located 2 or more grades above their average ability, that the chances are 6 in 100 that in one of their abilities they will be "at grade." The same statement may be made for the 11 per cent located 2 or more grades below their average ability. Similar observations may be made for those a grade above or below their average score. In imagination superimpose the top frequency curve upon the middle one. Center it at various points along the base line of the middle distribution and you have pictured how much the individual pupil's school abilities vary around his own average or general ability.

The chief observation to make at this point is that the abilities of an individual pupil are only 20 per cent less varied than are the general abilities of the pupils in the grade. This fact needs emphasis. Teachers are more aware of the facts of individual differences. They think too exclusively in terms of general ability. The concept of general ability and the concept of pattern of specialization are complementary. Either alone supplies a very inadequate picture.

Specialization When Intelligence Tests Are Used

When ability to learn is measured by intelligence tests and specialization is described in terms of the several abilities measured by the test, specialization is even more pronounced as compared with the spread of average ability in an age or grade group. Taking the central tendency of data presented by Balinsky,[10] Peatman,[11] and Thorndike,[12] the G line is about six-tenths as long as the lines for the several abilities averaged, and the S line is a third longer than the G line.

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[10] Balinsky, B., "An Analysis of the Mental Factors of Various Age Groups from Nine to Sixty," *Genetic Psychology Monographs*, 1941, 23:191–234.

[11] Peatman, J. G., "A Study of Factors Measured by the Thorndike Intelligence Examination for High School Graduates," *Archives of Psychology*, 1931, No. 128.

[12] Thorndike, R. L., "Factor Analysis of Social and Abstract Intelligence," *Journal of Educational Psychology*, 1936, 27:231–233.

When the intelligence tests are made up entirely of "performance" tasks, the specialization is still greater. The G line is less than half as long as the reference line (spread for one part of the test) and the S line is twice as long as the G line, being only 10 per cent shorter than the reference line.

Specialization among Measures of Learning

Measures of learning were questioned in the preceding chapter as adequate indications of ability to learn. Accepted at their face value they would lead to the conclusion that there is very little basis for a concept of general ability to learn. The data reported by Hall,[13] Husband,[14] and Woodrow [15] show a G line only 40 per cent as long as the reference line, and an S line 2.3 times as long as the G line and only 8 per cent shorter than the reference line.

Those who are inclined, on the strength of these data, to minimize the importance of the concept of a general ability to learn find support in the field of comparative psychology. Tryon's data led him to conclude "that there is no such fact as *general* learning ability, but rather that there are *numerous learning abilities.*" [16] It should be noted however that the abilities which have contributed most of the data are of a performance nature. If the measures are adequate for the purpose, as defined in the previous chapter, the conclusion which should be drawn is that measured motor or performance abilities are not nearly so generalized as are the abilities usually measured in an intelligence test, and still less so as compared with school achievement-test abilities.

[13] Hall, C. S., "Intercorrelations of Measures of Human Learning," *Psychological Review*, 1936, 43:179–196.

[14] Husband, R. W., "Intercorrelations among Learning Abilities," *Journal of Genetic Psychology*, 1939, 55:353–364.

[15] Woodrow, H., "Interrelations of Measures of Learning," *Journal of Psychology*, 1940, 10:49–74.

[16] Tryon, R. C., *Comparative Psychology* (F. A. Moss, ed.), Chap. 12, "Individual Differences," New York, Prentice-Hall, 1942, p. 356.

Dependence upon the Group Reference

The reader is again reminded of the dependence of such observations as have been offered above, upon the nature of the groups tested. The groups furnishing the data for the school achievement-test and intelligence-test data were in this case age or grade groups. Had the data been secured from the testing of more heterogeneous groups the observations would have been different. Data from the measurement of two very different groups with the same test will illustrate this fact. The Army Alpha test scores for a college sophomore group[17] show an S line 60 per cent larger than the G line, but the scores of an army group[18] show instead the G line the longer, in about the same ratio. In the data for the college group, one is impressed by the amount of specialization of ability. On the other hand, in the army group data, one is impressed by the relative importance of the concept of general ability. The reader should remember that an increase in the heterogeneity of the group strengthens the case for generalization, and that homogeneity, on the other hand, strengthens the case for specialization.

Specialization as Shown by Factor Analysis

But the answer to the question, "How specialized is ability?," is a function not only of the group which provides the standard of reference; it is a function of the tests used. Tests vary a great deal as to the extent to which it may be said that one test measures only one ability.[19]

A mathematical effort to analyze the results of testing programs with the idea of discovering a more precise basis for charting man's abilities has been under way since 1904.[20] This effort, known as factor analysis, has been directed toward finding how many factors are necessary in order to account mathematically for the results of present methods of testing with a great variety of the existing tests. Following this analysis, an effort is made to find, modify, or make tests which will give scores such as are called for by the analysis. If all the uses of testing could be served by the administration of a reasonable number of precisely defined tests of homogeneous content, a great economy would be effected.

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[17] Unpublished data. Scores for 86 New York University, Washington Square College sophomore men.

[18] Yerkes, R. M., ed., *Memoirs of the National Academy of Science,* Vol. 15, 1921. $n = 1047$ men in 9 camps.

[19] Thorndike, E. L., "Unity or Purity in Traits and Tests," *Occupations,* April, 1934, 12:No. 8, 57–59.

[20] Spearman, C., "'General Intelligence' Objectively Determined and Measured," *American Journal of Psychology,* 1904, 15:201–293.

Thurstone [21] describes, as follows, the abilities which he thinks have been most satisfactorily defined: S, "the ability to visualize flat figures or solid objects"; N, "facility in doing simple numerical tasks"; V, "verbal comprehension"; W, "word fluency"; M, a memory factor "represented best in the ability to remember paired associations"; and I, induction, "the ability to discover the rule or principle in the material that one is working with."

Factor analysis research has emphasized the specialization of ability. It has counteracted a too great tendency to think that it is enough to know a pupil's general ability to learn. It had a tendency for a while to go too far in this direction, and discredit the concept of general ability altogether. But it is clear now that in spite of the fact that the groups tested have been selected for homogeneity, and that factor scores are as independent as possible, the results are not fully described without a concept of general level of ability.[22]

Data obtained from the use of the *Primary Mental Ability Tests*, experimental edition, 1938, show that even if only one test is used for each factor there is an intercorrelation of scores equal to about .20 for single grade groups.[23] This indicates an S line which is almost 90 per cent as long as the reference lines, and a G line which is about 45 per cent as long as the reference lines for the separate tests. This degree of specialization is about the same as that reported above for intelligence as usually measured with performance tests.

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[21] Thurstone, L. L., "Theories of Intelligence," *The Scientific Monthly*, February, 1946, 62:101–112.

[22] *Ibid.*, pp. 109–110.
Also Thurstone, L. L., "Psychological Implications of Factor Analysis," *The American Psychologist*, September, 1948, Vol. 3, pp. 402–408, especially pp. 403–404.

[23] Coombs, C. H., "A Factorial Study of Number Ability," *Psychometrika*, January, 1941, 6:161–189.

The Concept of Special Ability

The reader may have noticed that the term "special ability" has been used sparingly in this chapter. It is a term which is very commonly used. The user may intend to convey no other meaning than that he is talking, not about ability in general, but about some special or particular ability. But some writers[24] mean by their use of the term a theory of mental organization. They think that most of the things we do reflect a general ability, but that there are some areas of ability which are independent of general ability, and these are called special abilities to indicate the independence.

Statistical analysis of measured abilities provides little support for the latter concept of special ability. What is found is that abilities vary on a scale from the one that agrees most closely with general or average ability to the one that is least in agreement. But all abilities tend to be positively correlated. None is "independent" or uncorrelated with the others. When they are lined up from high to low agreement, the drop is gradual. It would require a quite arbitrary decision to draw a line somewhere in the list, and to say that the abilities falling below the chosen point were "special" abilities. It is because of this fact that it has seemed better not to use the term. Instead it is pointed out that for each and every aspect of ability there is a measure of correlational agreement with general or average ability and a

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Goodman, C. H., "A Factorial Analysis of Thurstone's Sixteen Primary Mental Abilities Tests," *Psychometrika*, September, 1943, Vol. 8, No. 3, pp. 141–151.

Stalnaker, J. M., "Primary Mental Abilities," *School and Society*, December 30, 1939, 50:868–872.

[24] Bronner, Augusta, *The Psychology of Special Abilities and Disabilities*, Boston, Little, Brown, 1917.

Freeman, F. S., *Individual Differences*, New York, Holt, 1934.

Hollingworth, L. S., *Special Talents and Defects*, New York, Macmillan, 1925.

measure of disagreement which is illustrated in profiles around the individual's average. This disagreement has been called specialization.

The best chance of finding an area of ability, measures of which might be uncorrelated or even negatively correlated with a general measure of ability, is in the area of motor, manual, or manipulative skills. The correlation of such ability with general ability is very low.[25] Hence it is conceivable that a school group might be found with enough acceleration and retardation to introduce a negative correlation. The retarded older students would register low intellectual ability and the high muscular ability which comes with age. The accelerated members would also contribute to the negative correlation. It may be that it is this situation that has caused people to think that the very bright are weak and relatively undeveloped. This is another case of the importance of qualifying the conclusion with a description of the reference group.

Among the abilities usually measured in an achievement-test battery, spelling and computational skill are the most specialized abilities; and the ability to get the meaning from words, sentences, and paragraphs is the least specialized.[26] In other words, it is with regard to arithmetic skills and spelling that the profiles may be expected to show the largest peaks and troughs. This observation is not offered as a universal. It is a central tendency. The order may be expected to vary from local situation to local situation, in groups of varying nature, with different bases for grading and sectioning, different patterns of curricular emphasis or neglect, and different tests. An example of an order quite different from the central tendency mentioned above is found in Burt's data.[27] They show thirteen school abilities to range from least specialized to most specialized in the following order: composition, arithmetic problems, history, geography, reading comprehension, handiwork, dictation, drawing, handwriting quality, reading speed, science, arithmetic rules, and writing speed.

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[25] Morris, R. S., "An Experimental Analysis of the Theory of Independent Abilities," *Journal of Educational Psychology*, 1941, 32:495–512.

[26] Kelley, *op. cit.*

[27] Burt, C., "The Relations of Educational Abilities," *British Journal of Educational Psychology*, February, 1939, Vol. 9, pp. 45–71.

Summary

In chapter ten, it was concluded that we are justified in using measures of what pupils have learned, and are at present able to do, as measures of ability to learn. In the present chapter, such measures have been examined in order to answer the question, "How specialized is ability?" The data show a great deal of specialization. In the grade groups with which teachers work, the specialized spread of abilities in the individual pupil's profile is almost as great as the spread of general ability within the grade group.

However, it was concluded that, although the fact of specialization is being emphasized (and should be), there is no justification for denying the importance of the concept of general ability. It would be a mistake to deny the importance of the concept of general ability in education in order to emphasize the existing specialization. The data do not justify the selection of a small list of "special abilities" independent of "general ability." Abilities vary by small degrees from the one which is least specialized to the one which is most specialized; but none are statistically independent or uncorrelated with general or average ability.

Throughout the chapter it has been emphasized that concepts and measures of specialization have meaning only when they are defined in terms of the spread of abilities within a reference group. Answers were offered in the chapter as dependent upon the make-up of the reference group, upon the tests used, and upon the pattern of educational influences involved.

Must the answers be so indeterminate? Is there nothing more basic to be said concerning the nature of ability to learn? The question of genetic determination is our next concern.

CHAPTER XII

"NATIVE" ABILITY TO LEARN

Traits Are Not Native or Acquired
An End to the Nature-Nurture Question?
Needed Redefinition of Terms
Physiological Basis of Ability To Learn
Controlled-Variable Observation
I.Q. Differences in Representative Samples
"Intelligence" and "Achievement" Tests
The Concept of Capacity
Development
Summary of Observations Concerning "Ability to Learn"

Up to this point the questions concerning ability to learn have been, "What measures of ability to learn are used?," "How valid and reliable are they?," and "How specialized is ability to learn as shown by objective measures?" The question for consideration in this chapter is, "In what sense and to what extent are measured abilities determined by inheritance?"

Traits Are Not Native or Acquired

Twenty-five or thirty years ago the question for this chapter might have been worded, "Is ability to learn a native or an acquired trait?" The effort at that time was to try to draw a sharp distinction. Although the tendency to classify as instinctive had already been greatly restricted, it was still common psychological practice to describe what man is and does by reason of his nature. In another category were the traits which are acquired, what man does because of his nurture.

Even in the field of genetics early theories favored such thinking. Genetic elements were postulated to correspond to each inherited trait of the mature organism, and the whole process of development, so far as these traits were concerned, was thought of as a mere unfolding of what was fixed and determined by inheritance.

This view is now seen to have been a mistaken one in two respects. In the first place, the mechanics of heredity are known to be far more complex than they were earlier thought to be. In the fruit fly, which has yielded a great deal of present-day knowledge concerning genetics, the mechanics of inheritance are relatively simple, involving only four chromosome pairs as compared with twenty-four pairs in man. But even in the fruit fly it is not a case of one gene per trait. For instance, twenty or more genes affect the eye color of the fruit fly.

Even more important for the definition of our question for this chapter is the fact that today geneticists realize that even in its earliest stages any developmental outcome is the result of an interaction between genetic factors and the impinging environmental factors. Furthermore, this realization is not a merely perfunctory recognition that an environment is essential. It is a realization that under all circumstances environmental conditions are influential in the determination of outcomes. It is thought for instance that the same kinds of genes are in all the cells of the young embryo. At a very early stage of development, given the right conditions, any cell can become any part of the body. What part it becomes depends upon the conditions under which its development proceeds. And even in later stages of the organism, influence has been demonstrated in areas which earlier were thought of as independent of environmental influences.

The nature-nurture question is therefore not one of sorting traits into two categories, native and acquired. All traits are products of *both* genetic and environmental influences. There is no unraveling of the effects of heredity and environment. This was made clear long ago by Jennings.[1] As he expressed it, "Experimental biology has shown that at its beginning the organism is a complex thing, containing a great number of separate substances . . . what we call the genes. By the interaction of these . . . substances with each other, with cytoplasm, with materials brought in from outside, with the forces of the environment . . . development takes place, the individual is produced with all his later characteristics."

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[1] Jennings, H. S., "Health Progress and Race Progress, Are They Compatible?," *Journal of Heredity*, 1927, 18:272. See also *The Biological Basis of Human Nature*, New York, Norton, 1930, and "The Laws of Heredity and Our Present Knowledge of Human Genetics on the Material Side," Chap. 1 in Jennings,

An End to the Nature-Nurture Question?

Does this inseparableness of heredity and environment render meaningless all nature-nurture investigations? In the opinion of the author, it does not, for reasons which will be stated later. However, there are some writers who think it does. According to Saucier,[2] "It would be fortunate for psychology and education to end the time-worn discussion of the degree of importance of heredity and environment. Both are necessary and interdependent . . ." If we ask, "Which is more important, heredity or environment?," Bruce and Freeman [3] say, "Neither . . . Although not all psychologists, social scientists and biologists seem to have realized it, the question is a gratuitous one and it has been shown, finds no support in scientific fact." A similar position is taken in an extensive review by Jane Loevinger.[4] Stoddard and Wellman [5] think that the discrepancies among the results reported by those who have made quantitative evaluations show that something is wrong about such efforts, ". . . for the size of samplings considered by most of these authors it should not be possible to find intellectual differences ascribable

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H. S., *et al.*, *Scientific Aspects of the Race Problem*, New York, Longmans, Green, 1941.

[2] From p. 76, Saucier, W. A., *Introduction to Modern Views of Education*, Boston, Ginn, 1937, by permission of the publishers.

[3] From p. 510, Bruce, W. F., and Freeman, F. S., *Development and Learning*, Boston, Houghton Mifflin, 1942, by permission of the publishers.

[4] Loevinger, Jane, "On the Proportional Contributions of Differences in Nature and in Nurture to Differences in Intelligence," *Psychological Bulletin*, 1943, 40:725, 756.

[5] From pp. 172–173, Stoddard, G. D., and Wellman, Beth L., *Child Psychology*, New York, Macmillan, 1938, by permission of the publishers.

to heredity to vary from 50 to 80 per cent. Obviously, there is something wrong with our experimental techniques or our definition of the problem. What is wrong . . . is that . . . 'Nature' and 'nurture' are intertwined intimately from birth onwards and no artificial, analytical separation is possible . . ."

Needed Redefinition of Terms

All are agreed that nature and nurture are inseparable, but a practical need for investigation remains. If we redefine the terms we need not stop calling some traits "hereditary" and some "environmental." There are some traits, environmental control over which is so obvious that we wish to minimize the part played by heredity. On the other hand there are traits over which we exercise little control, so far as we are aware of it. In referring to these traits, we overlook the environmental factors. We call the former traits environmental and the latter traits hereditary. There is no harm in such usage if it is understood, as indicated above, that the terms refer to the degree of environmental control which has been observed.

For instance, evidence has shown the I.Q. to be affected by a variety of circumstances. The I.Q.'s of a group of English children were (seemingly) gradually lowered 30 points because of a lack of schooling while these children were living with their parents on canal boats.[6] After less than two hours of coaching and a three-week interval, the I.Q.'s of thirty-three children were about 26 points higher because of the coaching.[7] The average I.Q. of a group of southern Ontario Indian children was 16 points higher on a nonlanguage performance test than on a verbal test.[8] After five months of treatment for epilepsy a young man's I.Q. was increased 24 points.[9] Data like these have minimized the tendency which has prevailed to think of ability to learn as a native trait.

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[6] Gordon, H., *Mental and Scholastic Tests Among Retarded Children*, London, *Board of Education Pamphlet 44*, 1923.

[7] Graves, Katherine (now Greene, K.), *The Influence of Specialized Training on Tests of General Intelligence*, New York, *Teachers College Contributions to Education No. 143*, Teachers College, Columbia University, 1924.

[8] Jamieson, E., and Sandiford, P., "The Mental Capacity of Southern Ontario Indians," *Journal of Educational Psychology*, 1928, 19:313–328.

[9] *Science News Letter*, June 1, 1940, 37:339.

Such data illustrate environmental influence upon ability to learn. They are not definitive however. They afford practically no basis for precise judgments as to the relative influence of hereditary and environmental differences.

Physiological Basis of Ability To Learn

Is a more definite answer available in the data of physiology? Most psychologists would welcome a resolution of the nature-nurture problem in physiological terms. The I.Q. is thought of as correlated with individual differences in the modifiability of the nervous system, and that modifiability is thought of as an innate characteristic of the organism. Strictly speaking, to identify a psychological trait with a physiological one does not rule environment out. But in practice, as stated above, there is a strong tendency to speak of a psychological trait as hereditary to the extent that it may be given physiological description.

Hathaway,[10] after pointing out that phrenological and other external measures have failed to show validity as index of ability to learn, wrote, "Direct study of the brain is more to the point, although as yet it has not been much more fruitful." Marquis [11] is similarly conservative in his chapter "The Neurology of Learning." Lashley and Wade go so far as to say that "at the present time nothing whatever is known concerning the nature of the alterations in the nervous system which constitute memory traces." [12]

There are, of course, some physiological and anatomical factors which are obviously related to specialization of ability, such as the muscular and skeletal patterns favorable for athletic skills, and the relation of vocal cords to singing. But in the main, for specialization, and particularly for general ability, the effort to define ability in physiological terms has afforded little information of a definite nature.

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[10] From p. 258, Hathaway, S. R., *Physiological Psychology*, New York, Appleton-Century, 1942, by permission of the publishers.

[11] Moss, F. A., ed., *Comparative Psychology*, New York, Prentice-Hall, 1942, Chap. 7.

[12] From Lashley, K. S., and Wade, Marjorie, "The Pavlovian Theory of Generalization," *Psychological Review*, 1946, 53:72–87, by permission of the American Psychological Association.

Controlled-Variable Observation

Useful conclusions must come in the main from the observation of behavior, but not from uncontrolled observation. Because we cannot separate a man into two parts, what he has inherited and what he has acquired, is not a sufficient reason for saying, "That should put an end to quantitative analysis." There are many areas of investigation in which the factors studied are inseparable. The method of science is to allow or plan variation in one factor at a time and to note the results.

In the field of genetics, Jennings[13] realized that every trait of man is the result of hereditary and environmental factors operating inseparably. But at the same time he made clear that observed differences in specified cases under known circumstances may be called hereditary or environmental as the case may be.

An abnormal abdomen develops on the fruit fly if a certain gene is defective. The geneticist says that the difference in outcome is due to a hereditary difference. But this development occurs only under moist conditions, and in this case, the geneticist calls the difference in outcome an environmental difference, which before he called hereditary. The kernels of a certain kind of corn are red in one case under the influence of a dominant gene, and green in another when both genes are recessive. The difference in color is then due to a hereditary difference. But even though the dominant gene is present, the kernels are red only in the light, they are green if kept covered. The difference in development is in this case due to an environmental difference.

In the same way, the question, "What is the relative importance of heredity and environment in producing differences in intelligence?," has meaning. The only sense in which it is meaningless is that it has no one answer for all kinds of situations. It would describe the situation better to say that the question has many meanings.

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[13] Jennings, H. S., *Biological Basis of Human Nature*, New York, Norton, 1930, pp. 127 ff.

To quote Jennings,[14]

> The answer to the question would be diverse, depending on the group of individuals concerning which the inquiry is made. For members of the same family, paradoxical as it may seem, the differences probably will be due more largely to diversity of gene combinations than to diversity of environment. The same is likely to be true for the differences between any small set of individuals belonging to the same social stratum, or living under similar cultural conditions; between the students at a given college, for example. But as we proceed to larger and more heterogeneous groups, the answer becomes less clear. In a single nation, as in the United States at the present time, probably the greater proportion of differences are still due to diversity of genes. As between nations of diverse cultures and traditions the role of these environmental factors becomes greater, possibly equalling or exceeding that of genetic differences. As between groups of mankind at different epochs of history the great differences may be attributed to differences in knowledge, in tradition, in type of culture, in the accumulation of inventions, etc., rather than to genetic differences in the populations in the different eras.

This is the type of statement which may be made concerning the influence of heredity and the influence of environment. More precisely described, it is not a statement concerning the influence of heredity or of environment. The correctly worded statement relates *differences* in outcomes under specified conditions to *differences* in heredity or to *differences* in environment or to both. Specified hereditary differences and specified environmental differences may then be compared as to their differentiating influence.[15]

Without an understanding of the validity of this type of investigation, miscellaneous nature-nurture data are bound to be confusing. Without it, they are confusing whether or not the reader is still incorrectly seeking an absolute answer to the question, "Is it or is it not a native trait?" Without this understanding one is confused if one set of observations emphasizes constancy,[16] and another fluctuation—one or the other observer is thought to be wrong. For one investigator to attribute differences to hereditary and environmental differences in the ratio of one to one, and another in the ratio of eight to two is thought to be evidence of the meaninglessness of quantitative analysis.

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[14] From p. 180, *The Biological Basis of Human Nature* by H. S. Jennings, by permission of the Publishers, W. W. Norton and Company, Inc. Copyright in the name of the Publishers, 1930.

[15] Howells, T. H., "The Obsolete Dogmas of Heredity," *Psychological Review*, 1945, 52:23–34.

It is true that the investigators have not always maintained a clear perspective. They have sometimes failed to realize or to report that the findings are specific to the groups and conditions which yielded the data. But the data are meaningful, and show consistently that in fairly representative samples of pupils, I.Q. differences are more closely related to differences in heredity than to differences in environment.[17] To one who realizes that findings pertain only to such groups as yield the data it is not surprising to find the different analyses to which Stoddard and Wellman referred. Holzinger's [18] finding that fraternal twin differences in I.Q. are about equally related to hereditary and environmental difference varies from other results in the direction expected.

I.Q. Differences in Representative Samples

The facts for I.Q. differences in representative samples have been referred to above. The treatment cannot be followed by a statistically nontrained reader. A simplified description using only averages is substituted here.

The average difference in I.Q. between the members of pairs of identical twins is about 5 points. This gives a measure at one extreme. The average difference between two people picked at random is about 18 points. This provides the other extreme. At one end the identical twins have the same genetic origin, and have lived in environments as similar as is possible for two people to have, because the twins are of the same age and sex, live in the same home, attend the same school, and are influenced by the same parents. At the other end of the scale, the difference is representative of the diversity in genetic origins and developmental influences in the general population.[19] The measures are 13 points apart, and this 13-point difference is a measure of how much difference in I.Q. is produced by the typical variety of heredity developed in the typical variety of environment. Now, with this 13-point scale defined with specified reference points, it may be asked what would happen to the 5-point difference for identical twins if they were separated very early in life and grew up under different developmental influences. Data are available for only 19 pairs.[20] The average of these 19 differences is 8.2 I.Q. points. From their position at the "zero" end of the scale they were moved only 3.2 points of the possible 13 points. Had the twins been placed in sufficiently diversified environments to qualify as a sample of typical environmental differences, the conclusion could be drawn (subject also to the extreme limitations set by the small number of cases) that environmental differences alone were responsible for only 3.2 points, or 25 per cent of the 13 points for which variety of both heredity and environment were responsible. Actually the environmental differences for the twin pairs are estimated to have been somewhat less than typical.

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[16] Thorndike, R. L., "'Constancy' of the I.Q.," *Psychological Bulletin*, March 1940, 37:167–186.

[17] Shuttleworth, F. K., "The Nature vs. Nurture Problem," *Journal of Educational Psychology*, November and December, 1935, 36:561–578, 655–681.
National Society for the Study of Education, *39th Yearbook, Intelligence: Its Nature and Nurture*, Bloomington, Ill., Public School Publishing Co., 1940.
Leahy, Alice M., "Nature-Nurture and Intelligence," *Genetic Psychological Monograph*, 17: No. 4, August, 1935.

[18] Holzinger, K. J., "The Relative Effect of Nature and Nurture Influences on Twin Differences," *Journal of Educational Psychology*, 1929, 20:241–248.

Now let us proceed from the other end of the scale, and ask what would happen to the 18-point difference if unrelated children such as show the 18-point difference have their environments made very similar. This happens when an own child and a child adopted at an early age are compared. An average for such pairs is 14.6 I.Q. points.[21] The difference for which hereditary and environmental differences are responsible has been reduced by 3.6 points, or by 26 per cent of the 13 possible points. To the extent that it is appropriate to think of environments as having been made alike for such pairs of own and adopted children, the other 74 per cent of I.Q. difference could be eliminated only by holding heredity constant also.

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[19] Taken from the Terman and Merrill standardization group. The 5-point difference for identical twins is for 151 cases reported by Hirsch, Holzinger, *et al.*, and Tallman and Merriman.

[20] Newman, H. H., Freeman, F. N., and Holzinger, K. J., *Twins: A Study of Heredity and Environment,* Chicago, The University of Chicago Press, 1937.

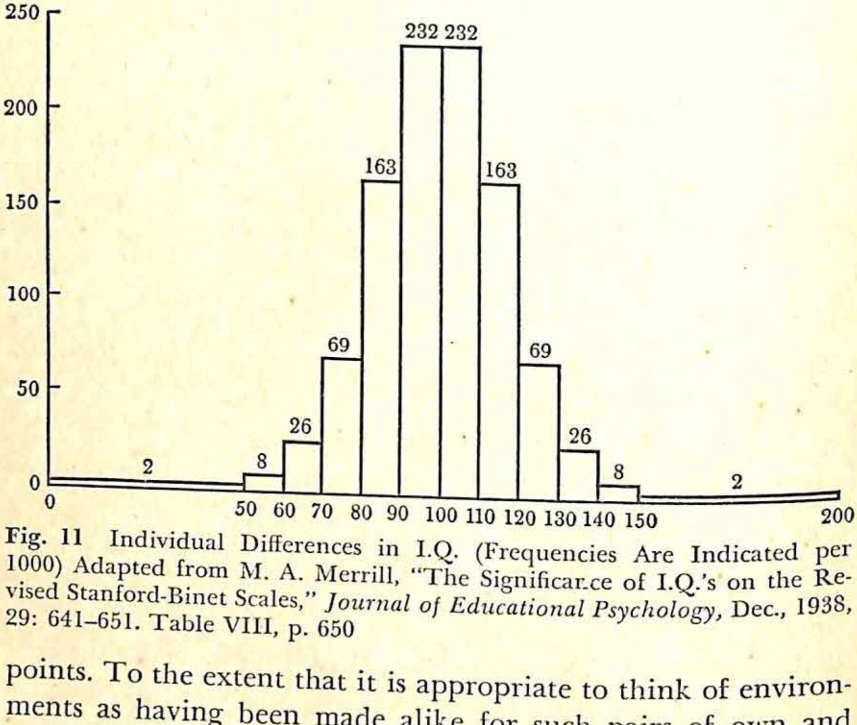

Fig. 11 Individual Differences in I.Q. (Frequencies Are Indicated per 1000) Adapted from M. A. Merrill, "The Significance of I.Q.'s on the Revised Stanford-Binet Scales," *Journal of Educational Psychology*, Dec., 1938, 29: 641–651. Table VIII, p. 650

This is the sort of inquiry which it is legitimate to make. It is not an effort to pick an *individual* to pieces, that is, to try to separate the inseparable. It is a group analysis, a question of individual differences. We face in the classroom a distribution of I.Q.'s like that shown in Figure 11. We ask, "How much more alike would they be if they had had the same environmental opportunities?" Such appraisals, as have been made of what happens when environmental differences are eliminated, and of what happens when they are introduced, suggest that the spread we deal with in a school, class, or grade would not be greatly curtailed. It might be as in the steeper curve instead of as in the flatter one of Figure 12. The data suggest that the individual

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[21] A combination of the Barbara Burks and F. N. Freeman data in the National Society for the Study of Education, *27th Yearbook, Nature and Nurture, Part 1, Their Influence Upon Intelligence*, Bloomington, Ill., Public School Publishing Co., 1928.

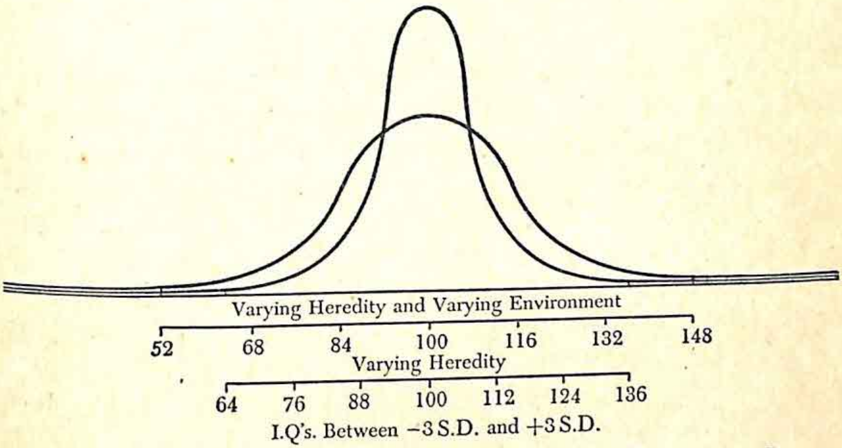

Fig. 12 The Extent to Which Individual Differences in I.Q. Are Due to Hereditary and Environmental Differences

differences in I.Q. which are commonly found in a public-school class are less a reflection of what we ordinarily think of as environmental differences than they are of the differences we call hereditary.

There is more agreement about this than the argument between "environmentalists" and "hereditarians" leads one to expect. Frank N. Freeman, who was the "environmentalist" in the N.S.S.E. *27th Yearbook,* expressed his opinion as follows: [22] "I think we are justified in saying that one's general intellectual ability, one's ability to perform intellectual tasks of a general character, is affected to a very large extent by the difference in one's education and in one's general environment. I am not prepared to say that this difference is as great as the difference in heredity. Perhaps it accounts for about a quarter or a third of the difference . . ." It may be surmised from this quotation that having a reputation as an environmentalist when the *27th Yearbook* was presented came not from an extreme environmentalistic position but simply from a reaction to an extreme hereditarian position.

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[22] Freeman, F. N., "Heredity and Environment in the Determination of Intelligence," *21st Annual Conference on Educational Measurement,* p. 26.

"Intelligence" and "Achievement" Tests

All the data which have been referred to in the preceding sections of this chapter have been "intelligence-test" scores. But one of the most important implications of the inseparable operation of genetic and environmental factors is that there is no fundamental difference between the "intelligence test" and the "achievement test."

There is a practical difference. The "achievement test" is made to correspond to school effort. Usually it does not even scramble the content. Each part or subtest is designed to be recognizable by the teacher as corresponding to one of his objectives. The questions are selected to constitute a good sample of the knowledge and skill for the development of which the school is considered responsible. There is no such need to make the "intelligence test" correspond to the school program. Sometimes the intelligence test looks like an "achievement test" because it contains reading, vocabulary, or arithmetic sections such as are found in "achievement tests";[23] sometimes there is little resemblance. But which kind of test is used makes little difference in the ranking of those tested.[24]

Whatever the abilities which are required by the "intelligence test," they are acquired; and whatever the abilities which are required by the "achievement test," they are intelligence. All these abilities are, as one of the author's students expressed it, the product of "herediment."

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[23] Two "intelligence" tests, the Army Alpha and the A.G.C.T., were used by the author as "achievement" tests with which to measure improvement in the educational level of the population. This was done primarily to help break down the historic distinction between "intelligence" and "achievement" tests. "A Measure of Improvement in American Education over a Twenty-Five-Year Period," *School and Society*, January 8, 1949, Vol. 69, pp. 25–26.

[24] See Chap. IX.

Perhaps you think of an "intelligence test" as fundamentally different from an "achievement test" in that it confronts the examinee with novel situations. It is quite true that the test maker has often tried to make the test of such items. But novelty is a relative matter. That is, there is always for such "novel" situations a pertinent background of information, skill, or familiarity which may or may not have been acquired or achieved by the examinee. And in the second place, a good achievement test is not devoid of "novel" aspects.

The Concept of Capacity

It has become increasingly apparent that the use of a test as an "intelligence test" rests not upon what the test questions are but upon the validity of the assumption that the examinees have tried equally hard to learn what the test requires and that they have had an equal amount of opportunity, help, and encouragement for learning it. This is so, because the purpose in making and using "intelligence tests" has been to get a measure of "native capacity to learn." The user makes the assumption stated above, and infers that the examinees are ranked by their I.Q. scores in the order of their "native capacities."

We have already commented in the preceding section upon the extent to which one is justified in making the necessary assumption, by reporting that I.Q. differences in representative groups correspond to hereditary differences more closely than they do to environmental differences. Probably the rank of pupils according to their "achievement-test" progress would serve the same purpose as well. It might even be a better indication than I.Q. is, of genetic difference. So far, a comparison has not been made of the relative validity of the two types of test. It would seem that since the "achievement-test" content for grades four to six is the content which is most universally taught, sought, and valued; that it is the content concerning which the necessary assumption could be made with the greatest amount of validity.

But regardless of the test used, it is important to remember that the effort in intelligence testing is to *rank* pupils according to genetic differences. Such testing supplies no absolute measures of "capacity." Buckets are describable in terms of absolute units of capacity, as for instance, ten-quart or twelve-quart buckets. Pupils are not educational buckets. We can know from the use of tests that the learning of two pupils has been progressing in a ratio of ten to twelve, but the tests provide no knowledge of limits.

Such knowledge of limits as we have comes not from the "intelligence" or other ability-test scores, but from our total experience with persons. If we are unable to conceive of any educational regime doing more for low-I.Q. pupils than has been done in the past, we say we know the "limits of their capacity." We could be wrong. If there should be discovered some environmental regime, educational, medical, or whatever, under which greater development took place, then it would be obvious we did not know anything about their "limits of capacity" in a general or absolute sense.

It is just as incorrect to think that "nature" alone sets limits as it is to think that "nature" alone is responsible for anything else. We can only say, "judging from observation of pupils with such I.Q.'s there is no basis for expecting this pupil *under the same conditions* to show mental development above certain limits."

If A has an I.Q. of 120 and B has one of 80, then B may be expected to show less mental development than A under a given set of circumstances. But if the given conditions are improved, both may be expected to show more development. We would expect A to profit more than B, whatever the improved opportunities. This relation of A to B is all that the I.Q.'s tell us. They do not justify us in thinking that there are no more favorable conditions for mental development yet to be discovered.

Development

We measure ability at various ages and note the course of development.[25] The curve resembles somewhat the curve for certain phases of physiological development.[26] It also resembles the effort made in our society to provide schooling. To attribute the curve to either influence would be a mistake. Every aspect of development is the manifestation of a nature-nurture process. Here again we have terms which need redefinition. Before it was realized that nature and nurture were inseparable, aspects of development were sorted into two categories; those for which nature was responsible, called maturation; and those for which nurture was responsible, called learning. We continue to use these terms as we use "hereditary" and "environmental": according to the amount of control with which we are familiar. Those aspects of development which we do not know how to control, or do not feel a need to control, we call maturation.[27] Those aspects of development over which we exercise a psychological or educational control we call learning.

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[25] Jones, H. E., and Conrad, H. S., "The Growth and Decline in Intelligence," *Genetic Psychology Monographs*, Vol. 13, No. 3, March, 1933.
Miles, Catherine Cox, and Miles, W. R., "The Correlation of Intelligence Test Scores and Chronological Age from Early to Late Maturity," *American Journal of Psychology*, 44:44–78.
Wechsler, David, *The Measurement of Adult Intelligence*, Baltimore, Williams and Wilkins, 1944.
Brooks, F. D., *Changes in Mental Traits with Age Determined by Annual Retests*, New York, *Teachers College Contributions to Education, No. 116*, 1921.
Thorndike, E. L., Bregman, E. O., Cobb, M. V., and Woodyard, Ella, *The Measurement of Intelligence*, New York, Bureau of Publications, Teachers College, Columbia University, 1926.
American Academy of Sciences, *Memoirs*, Vol. 15, Washington, D.C., Government Printing Office, 1921.
Jones, H. E., assisted by Conrad, H. S., and Horn, A. "Psychological Studies of Motion Pictures, II. Observation and Recall as a Function of Age," *University of California Publications in Psychology*, Vol. 3, No. 6, August 18, 1928.
Meuman, E., *The Psychology of Learning*, New York, Appleton, 1913. Translated by J. W. Baird from the 3d ed. of *The Economy and Technique of Learning*.
Thorndike, E. L., Bregman, E. O., Tilton, J. W., and Woodyard, Ella, *Adult Learning*, New York, Macmillan, 1928.

[26] Robbins, W. J., Brady, S., Hogan, A. G., Jackson, C. M., and Green, C. W., *Growth*, New Haven, Conn., Yale University Press, 1928.
Wertham, F., *The Brain as an Organ*, New York, Macmillan, 1934.

[27] McGraw, Myrtle B., "Maturation of Behavior," Chap. 7 of *Manual of Child Psychology*, edited by L. Carmichael, published by John Wiley & Sons, Inc., 1946.

Summary of Observations Concerning "Ability to Learn"

Problems of measurement were considered first, because the question has been raised by some writers whether or not the status measures usually available are valid measures. In chapter ten the criticisms leveled against ability scores as measures of ability to learn were considered and rejected. How much has been learned is, at present, the best available measure of ability to learn.

With this question of procedure settled, the question, "Is there a general ability to learn?," was considered in chapter eleven. The data examined in this connection showed that there is a great deal of specialization of ability to learn. Probably the concept of general ability to learn does need de-emphasis in education. However, there is no justification for going so far as to deny the usefulness of a concept of general ability to learn. There are areas of ability, particularly performance in the motor or manipulative areas, in which general level is of little significance; but within the area of school or scholastic abilities, general level of ability to learn is an important practical consideration.

Is this general ability to learn a native trait? This question, "Is ability to learn a native trait?," was found in the present chapter to be in some need of revision. One should not ask concerning any aspect of personality, "Is it a native trait?," because all traits are the product of a developmental process of which genetic and environmental factors are inseparable aspects. Ability to learn cannot even be described in physiological terms with any definiteness. One can only speculate as to the nature of the neurological correlates of the observable individual differences with which we are practically concerned.

The appropriate question to ask is, "To what extent are individual differences in ability to learn due to environmental differences on the one hand, and to what extent due to supposed genetic differences on the other?" But having worded the question more appropriately, we found it difficult to answer it, and the answer obtained is not a general truth. It pertains only to the kind of people and the kind of environments involved in the investigations which provide the data.

Some research has been undertaken to answer this question under circumstances thought to be similar to those typically found by the teacher in his classroom. The results suggest that the I.Q. differences with which the teacher deals are a closer reflection of genetic differences than they are of environmental differences.

In such research the data has been secured by the administration of the so-called intelligence test. It is not known how the results would have differed had achievement tests been used; or that they would have differed at all. Obviously, since traits are not classifiable as "native" *or* "acquired," the distinction which historically has been drawn between the intelligence test and the achievement test should be no longer made. As people get used to the idea that the intelligence test does not "measure" heredity any more than an achievement test does, they will realize that tests give us no direct knowledge of "capacity."

The inference that test scores reflect genetic differences rests upon an assumption which is often, if not usually, of questionable validity. Because of this fact, the word "ability" should be used as often as possible without implications as to native potentiality, to mean simply what a person can do and learn at the given stage of his development. What he knows and can do, regardless of causes, is an important determiner of the pupil's progress in a given learning situation. Perhaps measures of present ability are *more* useful, rather than *less, because* they are *not* perfect reflections of genetic differences. At any rate, ability to learn, so measured and defined, exercises a control over learning. Other aspects of control were the subject matter of Parts I and II.

CHAPTER XIII

PERSONALITY

The Personality Inventory
Projective Techniques
Personality Types
Education Falters in Personality Appraisal
Quantitative and Qualitative
Rating
Cooperation in Appraisal
Summary of Part III

The Personality Inventory

The questionnaire has been thought of as the instrument for the measurement of conduct, as the test is the instrument for the measurement of ability.[1] It was pointed out in chapter nine that in a strict sense we cannot measure in the area of ability. But whatever it is that is done when one counts the number of things the pupil knows or the number of tasks he can do, can be done with as much justification in any area of personality so far as the theory of measurement is concerned.

There are differences, however, which militate against the validity of the questionnaire results. Everyone knows what is considered praiseworthy in taking an ability test. There is no ambiguity in the motivation; it is to do as many as you can, answer as many questions correctly as you can, etc. But in filling out a questionnaire designed to provide a self-description, the student may or may not know what kind of a response will place him in a favorable light. Furthermore, he is free to misrepresent himself on many questions in either of two directions. In other words, when it comes to a personality inventory or questionnaire, the person filling out the blank is freer to picture himself as he sees fit. It is true that in taking an ability test the examinee is free to represent himself as less well informed or less able than he really is. There may be occasions in which the examinee would care to so represent himself, but probably there are not many. The examinee is not free to misrepresent himself in the other direction unless he has an opportunity to copy.

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[1] Symonds, P. M., *Diagnosing Personality and Conduct*, New York, Appleton-Century, 1931, p. 122.

That responders to personality questionnaires do have a considerable leeway in self-representation has been shown with data.[2] Thirty-four students were asked to reanswer the questions on the Strong Vocational Interest Blank in such a way as to appear to be more like engineers in their interest patterns. One became less like them, twelve received the same letter rating for having the interests of engineers, but twenty-one scored a higher letter rating.

Forty-six students were asked to reanswer the questions on the same blank so as to appear to a hypothetical hiring board of education like better candidates for a position as superintendent of schools. The average effect was several times as large as needed to be considered "statistically significant." [3] The changes in interest score were reported as uncorrelated with intelligence-test scores. This unexpected result was probably due to the fact that those with the higher intelligence-test scores had registered the interests of school administrators to a greater degree on the first occasion. It is one of those situations like those described in chapter ten, where those with the high scores to begin with are most capable of raising them, but make the lesser increases in score because they are already nearer the maximum. A correlation of .24 appeared between change in interest score and intelligence-test score when initial score was held constant.

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[2] Terman, L. M., and Miles, C. C., *Sex and Personality*, New York, McGraw-Hill, 1936.

Steinmetz, H. C., "Measuring Ability to Fake Occupational Interest," *Journal of Applied Psychology*, 1932, 16:123–130.

[3] This is a term which the statistician uses to describe a statistic when he thinks it is unreasonable to attribute the measure to chance. The probable error of a pupil's score, described in Chaps. IX and X, is only one of the many kinds of probable error which are needed in research and in the reading of the results of research. In this case, the statistic reported is an average of 46 changes in score. The statistician says, "Suppose that the changes are no more than chance changes? How often might one expect a result like that reported?" With his formulas and tables, he answers this question. Then, as a sort of convention among statisticians, if the result would not be expected by chance more than 5 times in 100 trials, and certainly if it would not be expected more than once in 100 trials, he calls the result statistically significant.

The sex and personality data on faking scores were supplied by fifty-two sophomores, nineteen men and thirty-three women. They took a battery of seven tests which had been selected by Terman and Miles as tests to which men and women are likely to respond differently. A scoring plan was devised to show the extent to which answers were like the answers of women in general or like men in general. The fifty-two sophomores took the test without knowing that the tests were designed to be scored for masculinity and femininity. They were asked to take the tests again and to answer as men might be expected to answer and to take them a third time responding in as feminine a way as possible. The average scores were as follows:

	Men	*Women*
naive scores	+ 67	— 56
masculinized scores	+209	+189
feminized scores	—141	—148

The difference between the groups at the outset was statistically significant, but it was not significant on the second nor on the third testing, although the differences were in the expected direction. But the reason for showing the data is to illustrate the changes which both men and women could make in their scores when they tried. All four of these changes were statistically significant.[4]

In many cases the responder may not know enough about his own status in comparison with others to enable him to describe himself correctly. If, without, this necessary knowledge of individual differences, he guesses his way through the inventory, the scoring plan instead of giving him an innocuous rating may rate him as "maladjusted." [5]

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[4] To say that a difference is statistically significant is not to say that it is significant in any other sense than the statistical one described above. In this case, however, when the students were asked to respond as the other sex would, the changes were larger than the original sex differences.

The data bearing upon the validity of personality questionnaires have been reviewed by Ellis.[6] This review was a very large task. Two hundred thirty-two sets of data were classified by Ellis as to their weight as evidence of the validity of the questionnaires used. He described the studies as "negative," "questionably positive," or "positive," finding 44 per cent negative, 20 per cent questionably positive, and 36 per cent positive. Combining the questionably positive and the positive gives a total of 56 per cent of the studies which indicate some acceptable evidence of validity, as compared with the 44 per cent in which the investigators failed to find acceptable evidence of validity.

In many cases, as Ellis pointed out (pp. 391–393), validation consisted merely of proof that the questionnaires used were not entirely lacking in validity. When an instrument is being recommended, the prospective user should be told how often he will be right and how often wrong if he uses the instrument for individual identification, or told the size of the probable error if he uses it for prediction. To demonstrate that two criterion groups make average scores which are different by statistically significant differences, or to assure the user that the questionnaire scores are "significantly" correlated with a criterion is the least that can be said for the validity of the questionnaire.

The data which render the validity of the personality questionnaires in general most suspect are the low intercorrelations between scores based upon different questionnaires designed to provide the same kind of information. One of the sections of the Ellis review was devoted to those studies in which there had been reported the extent to which different questionnaires provide a similar ranking of those who answer them. The median of the fifty coefficients of correlation in Ellis' Table I (pp. 412–413) is about .40. This is a much lower intercorrelation than has been reported for intelligence tests. The intercorrelations for the scores on five different group-intelligence tests taken by the same one hundred sixty students ranged from .71 to .88, and averaged .82.[7]

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[5] Burnham, P. S., and Crawford, A. B., "The Vocational Interests and Personality Test Scores of a Pair of Dice," *Journal of Educational Psychology*, 1935, 26: 508–512.

[6] Ellis, Albert, "The Validity of Personality Questionnaires," *Psychological Bulletin*, September, 1946, 43:385–440.

Among the two hundred thirty-two studies reviewed by Ellis there were fourteen which reported correlations between questionnaire scores and average ratings by teachers or associates. The median of these correlations, about .44, is in one sense as good a measure of the validity of personality inventories for school use as is available. A correlation of the same amount was illustrated in Figure 3, in chapter ten. It may be seen there that a questionnaire score may be accepted as a substitute for what a student's associates know about him with the same confidence (or lack of it) with which an I.Q. may be used to predict college marks. The probable error of estimating in terms of A, B, C, D, or E is .6 of a letter grade. In other words, one is as likely to be in error by more as by less than that amount, and may occasionally be in error by as much as four times that amount. By making this comparison with intelligence-test scores it is not meant to suggest that personality inventories are in general as useful as intelligence tests. At any rate, they are not so considered.[8] Although psychologists are aware of the errors involved, they are in agreement in thinking that the use of intelligence tests in schools is helpful. But the great majority of them have their doubts about the practical usefulness of personality inventories.

Projective Techniques

Personality inventories have been discussed at some length because of the extent to which they are used in school situations.

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[7] Miller, W. S., "Variations of IQ's obtained from Group Tests," *Journal of Educational Psychology*, 1933, 24:468–474.

[8] Kornhauser, Arthur, "Replies of Psychologists to a Short Questionnaire on Mental Test Developments, Personality Inventories, and the Rorschach Test," *Educational and Psychological Measurement*, 1945, 5:3–15; and "Replies of Psychologists to Several Questions on the Practical Value of Intelligence Tests," *Educational and Psychological Measurement*, 1945, 5:181–189.

There is need for students in educational psychology classes to be informed about them. There is less need to know about the personality tests, which are known as projective techniques because they are clinical tools. They are like the Stanford-Binet and other individual intelligence tests in that one needs clinical training and judgment to use and interpret them. But some modification of these techniques may be as satisfactorily adapted for group testing as intelligence testing was during World War I. Experimentation is under way with this end in view,[9] but for the present the use of the technique in schools could not be justified except for research purposes.[10]

The use of the term "projective" to describe these clinical techniques is very apt. The characteristic which they have in common is a vagueness of form or structure or in the meaning of the test materials. This provides a large amount of leeway for people to read their own individual life and personality into the situation. The less definitive the situation is, the less structured, the more uncertain the meaning, the freer he is to draw on that which has been prominent in his own experience, and the more likely he is to reveal this in his responses.[11] Teachers should see nothing mysterious about the use of such techniques, for whenever free play has been a part of the school life, teachers have gotten acquainted with their charges as they watched them with construction, and plastic materials, and paints. Teachers of older children have learned much about their pupils from free drawings, compositions, and oral reports.

The temptation to be avoided is the tendency to accept whatever insight a situation provides as the whole truth. Perhaps teachers are not tempted in this direction as much as clinical psychologists are. They shouldn't be. Teachers have noticed that there are many sides to their pupils. This renders them, or should render them cautious about accepting one glimpse as adequate. Furthermore, they are not pressed for time in which to get their knowledge of their pupils. Clinical psychologists have a relatively short time in which to get their data and make their interpretation. Especially if they lack experience and judgment they are tempted to think wishfully that by the use of a few favored tests the full personality is revealed.[12]

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[9] Harrower-Erickson, Mollie R., "Large Scale Experimentation with the Rorschach Method," *Journal of Consulting Psychology*, 1943, 7:120–127.

[10] Blair, G. M., and Clark, R. W., "Personality Adjustments of Ninth Grade Pupils as Measured by the Multiple Choice Rorschach Test and the California Test of Personality," *Journal of Educational Psychology*, 1946, 37:13–20.

[11] A popular description of a projective technique appeared in the October 7, 1946 number of *Life*.

For a 37-page review of the psychological literature, see Sargent, Helen, "Projective Methods: Their Origins, Theory and Application in Personality Research," *Psychological Bulletin*, 1945, 42:257–293.

For a more extensive description, see Bell, J. E., *Projective Techniques*, New York, Longmans, Green, 1948.

Personality Types

The too-easy solution to the problem of knowing our pupils which we are most tempted to accept is to type them. As Allport [13] has so well said of this tendency, there is just enough validity in the various bases for classifying people to make typing tempting, but not enough to make it profitable.

There are data which appear to contradict this appraisal in the case of Sheldon's [14] plan for the description of people on three scales, as visceratonic, somatatonic, and cerebretonic personalities.[15] Ratings on these three scales were found to correlate .79, .82, and .83, respectively, with ratings of physique on endomorphic, mesomorphic, and ectomorphic scales. A question needs to be answered before these coefficients are accepted at their face values as validity coefficients. To what extent were the personality appraisals biased by the earlier attention to physique? In other words, are the personality ratings limited to the things which are rather obviously dependent upon the kind of body one has, such as eating, sleeping, energy, and posture?

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[12] In the literature a too enthusiastic claim (Wekstein, Louis, "X-Raying the Personality: An Interpretive Evaluation of Two Projection Techniques," *The Scientific Monthly*, 1947, 45:133–142) invites ridicule. See Steinmetz, H. C., "Obfuscating Personality," *The Scientific Monthly*, 1948, 46:87.

[13] Allport, G. W., *Personality: A Psychological Interpretation*, New York, Holt, 1937.

[14] Sheldon, W. H., Stevens, S. S., and Tucker, W. B., *The Varieties of Human Physique*, New York, Harper, 1940.

Sheldon, W. H., and Stevens, S. S., *The Varieties of Temperament*, New York, Harper, 1942.

Sheldon, W. H., "Constitutional Factors in Personality," Chap. 17 in *Personality and the Behavior Disorders*, Hunt, J. M., ed., New York, Ronald, 1944.

[15] In a sense, as Sheldon claims, his system is not a system of types; it is rating of an individual on three axes. But since the three kinds of rating are negatively correlated, the result is to sort a large number of individuals into one or another of three categories.

There is a reason for urging caution against a too ready acceptance of easy solutions to the problem of personality appraisal. If, as it seems, there is at present no easy way for teachers to know their pupils as individuals, education suffers by any belief to the contrary. It suffers in that the education of many individuals is inefficient because based upon inaccurate premises and diagnoses. It suffers also because belief in the supposed easy way detracts from the zealous observation program which is needed. The teachers who are thus easily convinced that they have a sufficient knowledge feel no need for a better understanding of their pupils and hence take no steps to get it. They even fail to make good use of such data as are available because of their belief that once you learn about the types all you need do to know people is to know their type.

Education Falters in Personality Appraisal

Some of the very prevalent typing of personalities in education may be harmful for another reason. It is based upon abnormal psychology. It is somewhat tragically ironic that the mental hygiene movement along with its great contribution to education has caused educators to describe normal boys and girls in terms of a psychiatric classification of disordered minds. Until a better case can be made for the existence of causal relationships between children's behavior and the serious maladjustments of hospitalized adults,[16] we in education will do well to take a more constructive attitude toward our work. If a child lacks some arithmetic habits which we think he ought to have, or has some

[16] See Klein, D. B., *Mental Hygiene*, New York, Holt, 1944; also Landis, C., and Bolles, M. Marjorie, *Textbook of Abnormal Psychology*, New York, Macmillan, 1947.

which we think he ought not to have, we proceed constructively and objectively to plan for the desired learning. We need to proceed within the same educational frame of reference, wholesome, positive, and constructive when the objective is in the area of personality adjustment, and we need to get our data about children in the same spirit. We are too often trained to think in terms of "syndromes," of "disease," and of "therapy," but this is not the language of education. We must rise above this training and think and talk in terms which are more hygienic and appropriate to the work of education.

Perhaps the readiness with which education has taken its cue from medicine is due to the fact that education had neither objectively defined goals nor an objectively described program in the area of personality development. Too often, it has been considered important to know pupils well as persons, only as an aid to the achievement of the school's traditional objective. In other words, the search for personality data too often has been designed to supplement other indexes, the better to predict future scholastic success; or as an explanation for someone's failure to make the expected scholastic progress.

But as schools develop positive and constructive plans for personality and character development, "knowing the pupil" will take on new meaning. The data now usually available will then be inadequate for efficiency in the direction of learning.

Back of most of the research which has been designed to supply measures of "native" ability to learn (see the previous chapter) has been the conjecture that the scores sought need to reflect the modifiability of the nervous system. This preoccupation with the efficiency of the brain is understandable in view of the educational preoccupation with intellectual development. As educational endeavor broadens to encompass all aspects of development, research effort will follow. For the teacher will need to know about other hereditarily affected individual differences. How much energy is available? How quickly is it available? How quickly will it be replenished? What emotional response patterns characterize the individual?

But educational endeavor need not and should not wait for this research effort. It should proceed to know its pupils in the broad areas of living, assuming for the present that the observed individual patterns of behavior may be modified, and gathering data only to the extent justified by the amount of use to be made of it. Good suggestions for child study[17] have been published from time to time. But for the sake of emphasis the remaining pages of this chapter call attention to some important phases of this problem of knowing the pupil.

Quantitative and Qualitative

Knowing and describing the individual pupil is not a strictly qualitative process to be contrasted with the quantitative or test approach to evaluation. The clinical or case method has been contrasted with the psychometric approach too often and with too much feeling.[18] As the late Carl Spearman pointed out, these approaches are complementary.[19] An example of how quantitative data may be woven into a good description of an individual pupil may be found in Jones's description of "John Sanders."[20]

It is profitable exercise to read a description of an individual and to note the frequency with which a background of quantitative knowledge of individual differences was necessary in the writing, and is necessary for the reading. For instance, take the "sample case study" in the English and Raimy *Manual* (p. 103). Scattered through the ten-page report are such statements as the following: David's home is described as +1.5 sigma on the *Minnesota Home Status Index*. Though David's grade location is 4.3, his score on the Pressey Intermediate Classification Test was 74, which is above the median for grade 6A. His score was typical for the 12–5 group though he was 9–5 when tested. His New Stanford reading age was 12–6. His Metropolitan grade-placement arithmetic score was 4.6. His Morrison-McCall spelling-grade location score was 3.4. David's teacher's marks are consistently A or B. David sat alone at 7 months and walked at 10 months. He spoke his first word at 15 months. During the 1st grade, he was absent 19 days; during the 2nd, 7; and during the 3rd, 8 days. At age 9–7, David weighed 105 pounds and was about 59 inches tall.

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[17] Bailey, Edna W., Laton, Anita D., and Bishop, Elizabeth L., *Outline for Study of Children in Schools,* New York, McGraw-Hill, 1933.
English, H. B., and Raimy, V., *Studying the Individual School Child,* New York, Holt, 1941.
Torgerson, T. L., *Studying Children,* New York, Dryden, 1947.
Strang, Ruth, "Studies of Individuals," *Review of Educational Research,* December, 1948, Vol. 18, No. 5, Chap. 2.

[18] Rosenzweig, S., "Fantasy and Its Study by Test Procedures," *Journal of Abnormal and Social Psychology,* 1942, 37:40–51.

[19] Spearman, C., "The Battle between 'Intuitionist' and 'Psychometrists,'" *British Journal of Psychology,* 1934, 24:403–407.

[20] Jones, H. E., *Development in Adolescence,* New York, Appleton-Century, 1943.

These are very obviously quantitative observations which can come only from a considerable amount of knowledge about individual differences, and which depend somewhat for interpretation upon a similar knowledge on the part of the reader. But there are other items in the description the quantitative nature of which is not revealed by the use of numbers. It is reported, for instance, that "as a little boy . . . David spent much time with his mother." Does this sentence mean anything except as it is offered as an evaluation by one who has observed widely in this respect and as a result knows the range of individual differences in amount of time spent with the mother? There are many such observations: "Inclined toward timidity," "fairly interested in having stories read to him," at age 5 "was ill much of the time," "he does not eat enough vegetables," "he does eat plenty of fruit," he "drinks much milk," "he spends much of his time" with a neighborhood group of boys, "at times David possesses much confidence in himself," he "has shown a healthy curiosity," he "is inclined to mingle with others," he has "varied interests."

All such statements are, in fact, ratings. The observer, whether aware of the fact or not, thinks of the "David" involved, against the observer's background of experience with a normative group. How David fits into that group determines how he will be described.

Rating

Rating is, in other words, a more important procedure than is generally recognized, because it is far more frequently used than people realize.[21] We rate people and things and events in our daily work and conversations. There is very little description that is not contributed to by rating. Obviously, then, a consideration of what makes for good and poor ratings [22] can make an important contribution to the reliability and validity of description.

It is equally clear that the meaning conveyed by the rating elements of description is dependent upon the background knowledge of individual differences in terms of which the reader interprets what he hears or reads. If that background has not involved the same kind of experience, the observer describes in terms of one kind of normative group, and the reader or listener is likely to interpret in terms of another and thus to get misinformation. One of the most important contributions which should be made by the study of individual and of trait differences is a greater awareness of the importance of definiteness and of agreement as to the normative background for the rating elements of description. The student who has been made conscious of this importance of individual differences is on his guard. Instead of unhesitatingly interpreting in terms of his own norms he asks what kind of normative group the describer had in mind.

Cooperation in Appraisal

Another aspect of the process of knowing the pupil which needs emphasis is cooperation. The gathering of pupil data needs to be a cooperative undertaking for three reasons. First, it needs to be cooperative in order to make the result more reliable. Appraisal in the areas of character development and personality adjustment is much more subjective than in the areas of reading and arithmetic. An objective attitude can be cultivated and should be, but objectivity can also be secured by the pooling of impressions. In the second place, a cooperative effort increases the validity of the knowledge. One teacher knows what the pupil is like in one type of situation, another teacher knows the pupil in a quite different sort of situation. The second teacher may know things about the pupil of which the first teacher has no knowledge. The pooled knowledge of all who know the pupil, if well interpreted, will ordinarily provide a fuller and more valid knowledge than that had by any one teacher. In the third place, knowledge of the personality and character of pupils needs to be secured cooperatively because often it needs to be used cooperatively. The opinion was expressed in chapter nine that the most important part of evaluation is not the formal program of evaluation but the noting of pupil behavior in the day-after-day course of educational activity. If this be granted in the areas of character development and personality adjustment, and if the educational effort in these areas is a cooperative one, it should be recognized that evaluation should also be cooperative. Those who are to use the information are, by reason of that use, in the best position to get it.

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[21] Some people do not realize that usually each item of personality questionnaires, check lists, and inventories is a request for a rating. In Chap. IX a "test" was described as made up of many tests (items). Similarly, here, a personality inventory may be described as comprised of many rating scales (items).

[22] Guilford, J. P., *Psychometric Methods,* New York, McGraw-Hill, 1936, Chap. 9.
Remmers, H. H., and Gage, N. L., *Educational Measurement and Evaluation,* New York, Harper, 1943, pp. 361–377.
Adkins, Dorothy C., *et al., Construction and Analysis of Achievement Tests,* Washington, D.C., U.S. Government Printing Office, 1947.

Cooperation between teachers has been described as valuable.[23] Cooperation which includes the pupils must not be overlooked. If pupils can influence and help each other they can also contribute to appraisal. Already their contribution is being explored with the use of the sociometric techniques.[24] The need for cooperation between parents and teachers has long been stressed, but becomes increasingly important as school people become more concerned about all aspects of development. And cooperation is needed not only between parents and teachers but between all who are making an educational effort. Occasionally workers in the fields of medicine, law, and religion, together with youth and social workers, cooperate with parents and school personnel, but such cooperation is seldom available except in the direction of the development of young people who are outstanding or serious problems. It should be secured more often and in cases where the objective is a still better development than would otherwise be had, as well as at present in the effort to secure a less undesirable development.

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[23] Jarvie, L. L., and Ellingson, M., *A Handbook on the Anecdotal Behavior Journal,* Chicago, University of Chicago Press, 1940.
Prescott, D. A., *et al., Helping Teachers Understand Children,* Washington, D.C., American Council on Education, 1945, Chap. 6.
Torgerson, T. L., *Studying Children,* New York, Dryden, 1947, p. 115.
Olson, W., *Child Development,* Boston, Heath, 1949, pp. 396–397.

[24] Jennings, Helen Hall, *Sociometry in Group Relations,* Washington, D.C., American Council on Education, 1948.

As a final point in this emphasis upon cooperation in the securing of the needed knowledge of pupils, attention is called to the need that it be secured under informed leadership.[25] Who takes this lead is not important. The important thing is that someone take the initiative and have responsibility and qualification for the coordination of the cooperative effort.

Summary of Part III

It was concluded that although overemphasized since the time of Binet and of Spearman's early work, there is some validity in the concept of general ability to learn. "Nature-nurture" research data indicate that individual differences in this general ability to learn are to a greater extent attributable to genetic differences than to environmental differences. Any test battery which broadly samples what has been learned may be used to provide measures.

Above and below the individual's general level of ability to learn is a large amount of specialization. As to the controls over this individual pattern of specialization exercised by genetic and environmental factors, there are no data comparable to those concerning general ability.

In spite of a substantial validity in the I.Q. concept as reflecting native differences, there are many reasons for not taking any particular I.Q. determination too seriously. All test responses are learned, and learned under great differences in opportunity and in motivation.

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[25] Jarvie and Ellingson, *op. cit.*
Prescott, D. A., *et al.*, *op. cit.*, Chap. 4.

There is no easy way to know the pupil satisfactorily either with respect to his ability to learn, what his present status is in an area of educational effort, or his progress in such an area. This is, in a way, a negative thing to learn from a study of educational psychology. But it is positive in its influence, if the informed student, realizing it, is thereby prevented from being satisfied with knowledge of very low or doubtful validity.

The teacher must not hesitate to make subjective evaluations when and where they are needed. On the other hand, there is no justification for subjectivity other than its necessity. The student of educational psychology as a teacher should be motivated to secure, to use, and to give to others needing it, a knowledge of his pupils which is more objective, more reliable, and more valid because of his training.

Too often data gathering in schools is not functional. Obviously, need and use should dictate evluation practice. All need to ask, "What are my pupils like in the areas of my effort?," and "Is the program bringing about the desired pupil development?" But teachers vary a great deal as to how much information of this sort they can profitably use.

As a concluding observation, teachers need to be warned lest they think that the formal evaluation program takes care of all the evaluation needed. However necessary it may be to secure data by means of a formal evaluation program, it should not be lost sight of that the most important part of evaluation must be informally incorporated into teaching. For teaching should be constantly geared to learning. This means not only knowing the pupils, as indicated in Part III, but being able to watch and direct the learning process with understanding and efficiency, as indicated in Parts I and II.

PART IV

SOME IMPLICATIONS FOR EDUCATION

PART IV requires little explanatory introduction. Its function is obvious. Having considered the psychology of learning, we ask, "What does it mean for education?" The first concern in chapter fourteen is the general nature of the bearing of the psychology of learning upon education. The remainder of chapter fourteen and all of chapter fifteen are illustrative only. As stated in the preface, the purpose has not been encyclopedic. The purpose has been, rather, with some exceptions for the sake of emphasis, to try to supplement the existing literature, and to encourage the reader in the search for interrelationships. Up to this point, the suggested interrelationships have been largely within the field of psychology, though prompted by educational need. Attention is now focused more sharply upon education.

CHAPTER XIV

EDUCATION AND THE PSYCHOLOGY OF LEARNING

The Nature of the Educative Process
A Basis for the Evaluation of Education
A Definition of Responsibility
Pupil Self-Direction as an Educational Objective
Adult Pressure in Education
Is the Development of Self-Direction in Education an Objective of Many?
Self-Direction of Education Is Not Generally Encouraged
Why?
Differences in Ability
Specialization
Individualism
Discipline
"The Whole Child"
Broader Application of the Psychology of Learning

The Nature of the Educative Process

What is the psychological nature of education? Our review has indicated that education is pre-eminently the planned introduction of novelty in the experiences of the learner: It is novelty in experience which educates, not repetition.

But novelty of experience does not necessarily mean things strikingly different: never seen, heard, felt, or done before. A great deal of novelty can be and is introduced by new patterning of the familiar experiences. Reading is essentially such a new organization of experience. New terms receive their meaning by an appropriate recall of the reader's experience. Things never seen are imagined with the help of memories of that which *has* been seen. In other words, the reading of a book reorganizes our experience into new patterns. We relive our experiences in new combinations. Furthermore, a mere shift of emphasis can and does contribute mightily to learning. A great deal of education comes from experiencing the old in a new light, from a different point of view, with a new appreciation, or with a new emphasis. Much learning is effected by a redirection of attention within familiar areas of experience.

After a novel situation has been experienced it can be experienced again with less assistance. It is in this sense that learning, and hence education, is a biological or psychological profiting from experience, a being able to repeat the experience with less prompting help.

Although it is novelty that enriches, education is not fully achieved with the spectacular advances for which novelty is responsible. The new learnings cannot be depended upon except under very favorable (i.e., similar) conditions of attention. The new gains must be consolidated if the learner wants them to function while he gives his attention to more novelty and the new learnings which it brings. He must forego new spectacular advances until the former novelty becomes familiar. With every practice, performance is cued with less attention, and hence becomes less vulnerable to interruption from distraction. A great deal of education is the provision in this way for preparatory automatization. A hierarchy of development cannot go on without it. Until the lower-order learnings are beyond the attention-claiming stage the higher-order learnings are difficult or impossible. Materials to be used must be familiar. The various responses which must be incorporated into the larger pattern must be easily and dependably at the learner's command. To use Thorndike's words, learning cannot proceed to new levels until the key situations are clearly identifiable and the needed responses are automatically available. Education is then not only the planned introduction of novel experience, it is also a provision for the reduction of the novelty after the novelty has made its contribution. And this brings us to a third important observation about the nature of the educative process.

The reason why situations need to be easily identifiable and responses automatically available is that attention needs to be free in order to make new learnings possible. Attention is the spearhead of learning. Wherever attention goes a cue is made with which, in the future, the learner recaptures the fullness of the experience of which the attention was the core. Education is, therefore, in an important sense, the direction of attention. To a great extent, the art of teaching is the art of controlling and directing attention. This is an old truth re-emphasized by our present-day consideration of the facts concerning learning. Recognition of its importance has suffered from a preoccupation with the importance of pupil initiative in education. This is unfortunate. However, to describe education as the planned introduction of novelty and as the direction of attention is not to deny the great importance in education of purposeful activity and problem solving. A problem solving situation provides for learning because it provides novelty, and purpose is valuable because it directs attention.

A Basis for the Evaluation of Education

The second important way in which the psychology of learning is or may be of value in education is its use in the evaluation of educational effort. To speak of education figuratively, too frequently it is thought that the only way in which the tree can be appraised is to wait and judge its fruit. "The only way education can be evaluated," it is said, "is to wait and see how the graduates perform."

For two reasons this is poor practice. One is that it takes far too long to make the appraisal. The second is that having waited years to make the evaluation, the implications are entirely too uncertain. The "product" observed is the product not only of the whole school system but of the total culture in which the youth has lived.

The appraisal needed is the appraisal not of the "product" but of the educational activities. The objectives need to be considered one at a time, and the question asked, "Are the experiences the pupils are having well designed to develop the pupils along the desired lines?" With a good understanding of the learning process, the appraisal may be made with a reasonable amount of observation. In this way the implications are definite and direct.

A Definition of Responsibility

The psychology of learning not only throws light upon the nature of the educative process, and provides a basis for evaluation, but it also helps to define responsibility for the direction of development. It is an important basis for deciding to what extent education should be thought of as responsible for child development. Our review indicates that development is directable to a greater extent than is generally realized.

The facts do not suggest an extreme environmental emphasis. A child's development is undoubtedly influenced by physiological predisposition, for instance toward activity or lethargy, emotional or unemotional response, and by obviously unique patterns of anatomical development. Much more knowledge is needed at this point. The objectives of education, broken down in detail, need to be examined one at a time for the evaluation of the limitations imposed upon controllability by maturational factors. Then generalization will be more defensible. But such facts as are available suggest that the parts played by maturation and learning are reversed rapidly during the preschool years. There is far more basis for thinking of the general development which we call education as being an acculturation than there is for thinking of it as a biological unfolding or growth, although it is both.

Mature personality and character are less genetically determined, and more a matter of learning, than was formerly thought to be the case. There is no alibi in psychology for a defeatist attitude toward the possibilities for the direction of development. In other words, our review of the psychology of learning suggests a greater sense of societal responsibility for directing the development of its youth.

There is some disinclination to exercise the control over development which has been described above as possible. As it is expressed, "The school cannot take the place of the home. The classroom can supply only knowledge; the parents must build the essential character."

This division of responsibility between home and school is in one sense psychologically impossible. Responsibility for defining the goals and for leadership can be arbitrarily assigned. But the process cannot be localized. Teachers do not and cannot take a strictly nondirective role. The parent, the teacher, or the learner, or someone else may exercise the dominant influence, but he cannot alone determine the resultant course of development. Nor can he be without influence. Therefore, the sooner it is recognized that the responsibility is a shared one, the more efficiently development will be directed. Perhaps it should be said, "the more efficiently it will be directed toward the socially approved goals." In one sense, as pointed out above, it will be directed whether we try or not, and whether we like the outcome or not. Development is directed by chance factors to the extent that those working with children and youth ignore their share of responsibility.

It may be that most of all that is learned is unplanned. Certainly much of it that constitutes the foundation upon which education rests, that is, the learnings which education assumes and without which it could not proceed, is unplanned. It is true that most parents give serious thought to the educational needs of their children, but adults do not go about living with much concern about their educational influence upon others. At an early age, children are exposed to, and interested in adult life lived without regard to its educational consequences. A great deal of children's time is spent in unsupervised play under whatever conditions prevail in the neighborhood. Here and there, by chance, an adult, an experience, an associate exercises a profound influence in the determination of what children learn.

Some of the disinclination to assume a greater share of responsibility for the direction of development is due to the mistaken belief that there is no use trying. Not only have educators heard over and over again that development is a matter of growth and maturation, but their sense of responsibility has been dulled by another psychological teaching. It is that there is no worthwhile learning to be had from teacher direction. It is another case of an emphasis carried too far. From efforts to modify a too-great teacher-centeredness of education some have gone to the other extreme.

It is true enough that learning is an active process, and there are still some for whom this fact should be stressed. Teaching is not writing on a clean tablet. The learner is very actively in the picture. It is in the course of and from his activity that he learns. But it should not be concluded from these facts that the learner's activity and hence his development cannot be directed. Every adult with educational responsibility should realize that the child learns what to like and what to dislike, what to strive for, and what to value and cherish. In other words, in finding development in such areas highly directable, we find a sense of responsibility for direction psychologically defensible.

The supposedly responsible adult who refrains from doing all in his power to direct child development in the way he thinks it should go cannot find justification for his choice in the psychology of learning.[1] A belief that one must in colorless fashion teach only "facts" and avoid influencing the young, seems, from considerations of efficiency, like a strange abdication and waste of good influence on the part of those who are most concerned about the welfare of the young.

There is, we conclude, no psychological reason for questioning the transmissive role which education has played in society. That role is in essence merely the affirmation of responsibility for directing the development of the young. *What* is chosen as the best of the social heritage is quite another matter. *How* responsibility is exercised is still another question. This will be more apparent in the following sections as we choose an aspect or area of education within which to illustrate how the psychology of learning bears upon the direction of educational effort.

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[1] Nor, as I see it, can he find any justification in the concept of democracy. Democracy does not demand that one hesitate to influence his fellows, young or old. It requires only that the influence be honest and aboveboard in every respect, prompted by concern for the general welfare and tempered with tolerance. Respect for the individual is very important, but there is no mandate upon the teacher to respect modifiable immaturity. Immature arithmetic habits are not respected. Nor should immature motives be.

Pupil Self-Direction as an Educational Objective

Let us consider an objective which some educators place high on their list (in theory at least), and one which in view of some of the facts of learning seems to be a very reasonable objective. It is that the school should shift to the learner the responsibility for the direction of his education and do it as fast as the learner can worthily and efficiently assume such responsibility.

The facts which make this objective psychologically defensible are as follows: 1. Assuming that it is desired that the adult should have the ability to direct the continuance of his education, he should have guidance and help in assuming it. Responsibility for self-direction is difficult to acquire. The student is more likely to continue his education if it is something which he is already directing than he is when the break is abrupt. 2. To have one's education all planned in detail for twelve, or sixteen, or more years not only fails to prepare the person for self-direction but minimizes the prospects of self-direction later. 3. For most purposes, the learner's activity or experience is most productive of educational development when the learner, in so far as he is conscious of motivation, thinks of it as his own.

Adult Pressure in Education

In the fourth place, a too exclusively adult direction of education may defeat its own ends. There is no doubt that an interference with efficient learning can be introduced by an adult impatience for progress. An annoying or anxious awareness of pressure to do or to learn may be fully as important a qualifying factor as low native ability to learn. It is not maintained that awareness of what is expected of one has no place in the scheme of things. It is not claimed that feelings of compulsion or of anxiety can be eliminated nor that they have no value. It is not thought that emotion can make no contribution to efficiency. But ordinarily fear and anxiety interfere with efficient performance. In a group situation, embarrassment and lack of confidence interfere with the quality of participation. Likewise, in what is designed to be a learning situation, memories of past failure or dislike are successful competitors for attention. They are, as it were, dogs in the manger. To the extent that such annoying feelings are dominant, the learning outcome is confined to learning a stronger tendency to retreat from or avoid such situations.

A good example of how, on the other hand, learning proceeds when these feelings are reduced has been accumulating from the practice of what is called nondirective counseling.[2] Often the counselee is prevented from solving his problem by just such blocking or interference as has been referred to above. But in the more comfortable and more objective atmosphere which the counselor provides, emotional interference subsides and the counselee is thereby permitted to think creatively and profitably about his problem, to see aspects and relationships not thought of before, at least not clearly. With these things clearly in focus for the first time a new understanding is gained, some learning has been possible which was previously impossible because an anxiety or other interfering emotional feature dominated the counselee's response. An exposition of this "nondirective" point of view toward counseling [3] is equally good as a plea for an educational practice well designed to favor the development of the habit of self-direction and to provide a learner attitude more favorable to learning.

All will admit that educational pressure upon children and youth is responsible for much inefficiency in learning and for some maladjustment. Parents and teachers are impatient for progress. They are not willing to wait for maturation, and from the start the curriculum is crowded. Throughout the entire span of education it is a case of too much and too soon, or too much and too fast, "and overcrowding in education as in housing means ill health, and turns the school into an intellectual slum."[4]

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[2] Rogers, Carl, *Counseling and Psychotherapy*, Boston, Houghton Mifflin, 1942.

[3] See especially pp. 89–90 referred to in Chap. VIII.

There is, of course, no justification for saying that in view of the facts of learning there is only one remedy. What is being said is that if you want to emphasize self-direction as a goal, these are the things which can be said for it, so far as the facts of learning are concerned.

The impatient pressure which is so prevalent is unwarranted. The facts with regard to adult ability to learn make it clear that there is no need for feeling so strongly that education must be encompassed within the years before the pupil "goes out into life." Whether it is desired that education be highly authoritarian or self-directed as soon as possible, it will help if practice is really based on the premise that education is a lifelong process. To make this a working basis for planning would surely take some of the undesirable urgency out of the present situation.

Is the Development of Self-Direction in Education an Objective of Many

It was stated above that to develop self-direction in education is an objective which some educators place high on their list. Is it high on the list of many? This question is hard to answer because educators are not very explicit about the hierarchy of objectives which governs their efforts. Those efforts would be more efficient if goals were clearly and operationally defined and listed in the order of importance. Without such definition, self-evaluation is as vague as the aim. As a consequence, many teachers, over long periods of service, are left unaware of how little they are doing to achieve some of the objectives to which they give lip service.

Self-Direction of Education Is Not Generally Encouraged

But whatever educators would say, practice in general does not deserve a rating "well designed to develop self-direction of education." There are outstanding exceptions here and there. In general, we start off valiantly in the lower grades, but then we are afraid to follow through. There are still far too many high school and college classes in which the process is a contest between instructor and instructed. Most of the instructors would be either shocked or amused at the idea of the student taking responsibility and the initiative for his education.

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[4] Livingstone, Sir Richard, *Some Tasks for Education*, London, Oxford, 1946, p. 7.

Teachers generally are authoritarians in the classroom. We are able to take a position on the platform, so to speak, because of the relative immaturity of our charges, and we are encouraged by the mores to assume such a role. Teachers with years of such experience find it very difficult to associate even with responsible students on a more democratic basis. Even on the graduate level, and with a professional motivation of students which can be trusted, instructors are too sure that the guiding hand must be theirs. And the students, even those with good ability, are quite uncomfortable for a period when placed in a situation in which they are expected to take the initiative.

Why?

Why is it that pupils are not encouraged more to be on their own in education? We used to find fault with parents who kept their children tied to their apron strings. Are there better reasons for pupils being tied to teachers? Some of the same reasons why parents are too possessive apply also to teachers. However, there are other aspects of the school situation which need mention.

Differences in Ability

Individual differences are great in every area in which we have good information. They remain, and often are accentuated, by zealous educational efforts for the development of each child. There is, then, good reason for believing that great differences would remain in ability for self-direction after reasonably efficient efforts to direct development in that direction. Undoubtedly many educators are lukewarm or skeptical about self-direction of education as a goal for all pupils because of a recognition of these probable individual differences. A few pupils would be well served. Would the others be as well off as they are now? Possibly not, but possibly better off. If most pupils received neither better nor poorer education while others were richly benefited, the net result would be very good.

It is not difficult to foresee that there are difficulties involved. A teacher can more easily ignore individual differences if he is free to do all the planning. If he is trying to foster the values, attitudes, and habits involved in self-direction, individual differences must be faced realistically. This involves a challenge which cannot be met by many teachers today.

One thing which may be said in passing is that the individual differences which will be discovered in these efforts will not bear a one-to-one correlation with the individual differences in ability with which we are so familiar. There is already enough appreciation of pupil initiative to have shown that even among the very dull some will develop interests which will lead them far, and profitably.

Specialization

And that leads to another consideration which causes educators to be reluctant to relinquish the detailed direction of education. As a result of more self-direction there would be a departure (or at least an apparent departure) from standardized objectives which would be very disturbing. There is such a strong belief in the importance of a common education for all, that people begin to feel annoyance when specialization encroaches upon the common curriculum.

The prospect gives pause for another reason. Are we as teachers prepared to give the help which students would need in the great variety of problems? It is easier for the teacher to keep things under control and to set the problems which he is prepared to solve.

Individualism

Still another factor which operates against self-direction of education is the association in people's minds between pupil initiative and individualism. In these days when we are so conscious of the need to get along together, no one is interested in an education which does not emphasize socialization. As a matter of fact, if left more to pupil direction, education might be a more socialized process than at present. We still proceed to a great extent on the basis of a theory of mental discipline and frown upon or belittle a pupil's learning except as it comes from his own "hard work."

Discipline

In fact, one of the most influential factors operating to keep the direction of education tightly in the hands of the teacher, right up to leaving age or to graduation, is the belief that pupils are not to be trusted with such responsibility. "Haven't we already gone too far?" is the feeling in setting the child up "subject to no law except his own wishes." Perhaps so. But some adults do not distinguish between the development of *responsible self-direction* on the one hand and *license* on the other. They do not realize that to provide for a growing dependable self-direction requires more, not less, adult direction than is now being given to the foundations of character. The development of self-discipline does not mean a negation of responsibility on our part. It does not mean a general abdication on all fronts. Teacher and parent need to use their maximum influence for some purposes and stand aside for others, as the welfare of the child and of others dictates. Provision for the development of responsible self-direction should involve no great educational hazards. The educational activity required will still be highly teacher-centered at certain times and for certain purposes.

"The Whole Child"

Perhaps the most fundamental inhibition is that as a teaching body we are pre-eminently subject-matter specialists. The thing the school has stood for most clearly is the organization of knowledge on levels of difficulty for mastery by the maturing pupil. It is not to be expected that the "knowledge" objective could readily yield first place even in the interest of the welfare of the individual and of society. Just as, over the years, the high school has rationalized its reluctance by crying "college requirements," so, for a long time, schools at all levels will cry, "These other aspects of development are the responsibility of the home and the church." Should the mandate be clear for the school to place character, citizenship, and adjustment above its knowledge objective, would it know how to proceed?

Broader Application of the Psychology of Learning

One thing which would help is a revision of educational thinking with regard to the psychology of learning. Too many people think that psychologically, pupils get knowledge one way, skills and habits by a second process, and appreciations, interests, ambitions, and ideals by a third. Statements are often made to the effect that you cannot teach values "as such," or you cannot teach attitudes "as such," or you cannot teach problem solving "as such." We have not as yet seen learning as all of one piece. We still think of "giving" pupils information but not their interests, or values, or attitudes, or appreciations. These "grow," or "develop," or "are acquired." What we can "give" our pupils we say we can teach; the rest we cannot teach "as such." Such distinctions reflect an inadequate understanding of the learning process. Pupils grow or develop their knowledge in the same sense that they grow or develop their skills and ideals. Likewise, these latter traits are given to pupils in the same sense that their knowledge is given them. With whatever labels it is referred to, the process, our review indicates, is one and the same. And the better the process is understood, the better it can be directed.

On first thought it seems as if it is much more difficult to direct the process as we broaden our educational aims. It seems as if it were easier to get pupils to have the experiences which add to knowledge as desired, than to manage for them to have the experiences which add to skill or character. But it is not safe to take this first impression at its full value for two reasons. For one thing, we are not as skillful in directing learning in the area we call knowledge as we think we are. A lot of superficial parrotlike language would have to be discounted before a fair comparison could be made. Then, too, the difficulty involved in getting people to have the necessary experiences for the other outcomes must be discounted because of our lack of experience.

Because of this lack of experience we as educators must approach the broader task with some humility. We need to remember, as pointed out above, that our unique specialty has been the organization of knowledge. If our task is broader, then we need rather to be specialists in the direction of development. Concern for a greater variety of educational outcomes will cause us to seek a better understanding of the learning process. In the meantime we might learn from those not in "educational" work who have a long experience in "teaching" people to value this and reject that, to like this and dislike that. Whenever we find in ourselves a tendency to belittle their efforts because they are not, like us, developing "the intellect," let us pause and ask, "What is more important than the *motives* of men?"

CHAPTER XV

FOR MORE EFFICIENT LEARNING

Adaptation to Individual Differences
Individualization Needed
Flexibility in Organization
Cooperative Effort
Integration
Guidance
Testing Program
School Marks
Promotion
Mental Hygiene
The Administrator
And Finally, Teacher Education

Now let us suppose that character, democratic citizenship, personality adjustment, and learning as a habit and hobby should become the supreme objectives of the school! How should the schools be administered so that learning might proceed more efficiently?

Adaptation to Individual Differences

Little if any help may be found in the history of efforts to adapt education to individual differences. These efforts have contributed little because they have introduced no departure from mass methods. The concept of differences which prompted the various organizational changes was too superficial. It was thought that by sorting pupils according to their knowledge, and then according to their ability to learn, the thirty-five or forty pupils in a section would be enough alike so that the process good for one would be good for all. This, it is now known, is not the case. For one reason, if you sort on one basis, pupils are very poorly sorted for any other purpose because of the amount of specialization in their development.

Individualization Needed

But there is a more fundamental reason why sorting is not the answer. Pupils come to any given class with the greatest imaginable variety of background for, and interest in what the teacher wants to teach. This is not a matter that can be taken care of in advance by some administrative device. Pick a group as you will, so that anyone would admit that it is quite homogeneous as educational groups go; then, as a part of the teaching of a given topic to this group, take time to make sure of the progress of each member of the group. You will find that there is a uniqueness in the process for each pupil. Each brings his own peculiar background for what is to be taught. Each will notice and attend to different things in the same teaching. Different procedures are required if the teacher wants to make sure that all attend to even approximately the same thing. All pupils may read the same book or listen to the same exposition, but no two are led to assemble and reorganize the same pattern of meanings.

This is not a recent discovery. Herbart sensed the dependence of the outcome upon what the pupil brings to the learning experience. But the Herbartian idea soon became a generalized procedure. It did not lead, as it should have done, to a realization of the need, not for "adapting to individual differences," but for the individualization of education. The individual need is not something that can be discovered by the administration of tests, nor taken care of in advance by an organizational device. It is something which must be discovered in the course of the educational process and met by such modifications of the process as the discoveries indicate.

Individualized education is, as it were, tailor-made to fit the pupil. In order that this may be effected it is not necessary that all education must involve one pupil at a time. A few teachers are very skillful in individualizing their teaching even with large classes. The word "individualization" is used not to suggest education on an individual basis but to urge that individual pupil's needs be the basis for planning. And to the extent that the school does elevate character and adjustment objectives above its traditional knowledge objective, individualization will be more rather than less important as a factor in the efficiency of the educational process.

Flexibility in Organization

Another thing which is going to be more necessary with more concern in the school for all-round development is a flexibility of school organization. The learnings which improve character come mostly in the course of a variety of activities, rather than from a class period on character. The same is true of citizenship and good adjustment and the more abiding attitude toward learning discussed in the preceding chapter. In short, life during school years will need to become more like life during the years which are to follow them. This alone will prevent school life from being as neatly systematized as it is at present. But added to this need, there will be the need to plan somewhat in the course of activities as indicated above in order to individualize the educational process. When educational efforts toward a given objective are confined to a given period of the day, a given room, and involve only one teacher, the individualization of the educational process does not disturb the smoothness of school administration. But a character objective must involve all activities, and all teachers. Hence, when a pupil's development requires a modified effort, the modification cannot be effected without changes which, under present practice, are not tolerated.

Cooperative Effort

There is a greater need not only for flexibility in organization but for cooperation. Although here and there teachers have worked cooperatively in carrying out the knowledge objective of education, by and large we have worked independently as subject-matter specialists. Responsibility for progress toward a character objective cannot be so neatly divided among us. Some one person can and should be responsible for the coordination or integration of effort, but *all* should help. *All* should help provide the knowledge of individual pupils which is needed as a point of departure. Also *all* should help in the effort to provide for the needed learnings.

In such a cooperative process, the pupils themselves should play an increasingly responsible role. This should be so not only that "responsible self-direction" may be developed but because the process can be made more effective if the influence of peers is included in the educational efforts.

Furthermore, the cooperative effort should include the influence of people and activities outside the school. For the school to place character, citizenship, and adjustment objectives above the knowledge aim, should not in any way lessen the responsibility felt in the home, and in the church. In order to get efficient learning it is immaterial who is responsible for a cooperative effort, or under what institutional auspices that responsibility is exercised. The important thing is that effort be as informed and as integrated as possible.

Integration

Administrative machinery designed to integrate community character-building efforts is no guarantee of the needed psychological integration. This is not to belittle the administrative effort to coordinate agencies, promote mutual understanding, and plan for the whole community. But approached from a consideration of the psychology of learning, the needed integration is an integration of all the influences impinging upon a given child so that they may be used as needed for the child's development. This is a psychological integration of influence around the individual child, not the administrative coordination of institutions. For every child one person should be responsible for the integration of educational influences. For one child it might be a parent, for another a minister, priest, or rabbi. It might be any school employee; home-room teacher, visiting teacher, subject-matter specialist, or principal. It might be a social worker, a Boy Scout, Y., 4-H, or playground worker. All who know and could help with the education of that child should be willing to cooperate under the chairmanship of the responsible coordinator.

Such an integration is available now for a few of the youth of the community. It is available, however, only to those who are the most troublesome and then only after good character development has been rendered very difficult by neglect.

Guidance

What will happen to guidance programs as this trend in education develops? Instead of being a supplementary service, it will be the heart of the educational process. When all school workers realize their cooperative part in the guidance process, there will be need still for workers who, more than the average teacher, have specialized in the psychology of learning and adjustment. They will be needed on difficult cases, and to continue to provide leadership. The farther this modification of education goes, the more widespread and habitual in-service improvement will be.

Testing Program

Most of the knowledge needed about pupil progress should be had as a necessary part of efficiently directed learning. If the direction is well individualized, it is done on the basis of an intimate knowledge of the pupil. There are, however, uses for tests. There will be those who will believe that the knowledge objective will be badly neglected if character and adjustment objectives are considered most important. The occasional administration of standardized achievement tests would provide objective evidence concerning the justification for such fears. To value character and adjustment above knowledge may not mean less progress of the sort which has been our prime concern. It might even make for more such progress. Pupils will want to take tests in the areas in which they want knowledge, for their diagnostic and prognostic value. They and their teachers will want to take very general tests for the same reason. When it is more widely realized, as described in chapter twelve, that intelligence tests do not by some hocus-pocus measure inheritance any more than achievement tests do, scores on intelligence tests will be used by pupils and parents just as freely as they are used by teachers. But not with the amount of emphasis placed upon them today. Again, such information will but supplement the more important knowledge which teachers will have about their pupils. When education is directed to meet the needs of groups, evaluation is a thing apart from teaching, staged usually at relatively infrequent intervals. But when education is individualized, evaluation is an inherent part of the process. It is a frequent reading of the compass to assure a steady course. Formal testing programs can play only a minor and supplementary role.

School Marks

Should school marks be abolished? No. But little can be said for their use as a club. Surely more, much more worth-while education may be had by fanning whatever flame of interest and zeal we may discover. There are so *many* patterns of development, *all* within the framework of good character, citizenship, and adjustment. What do we gain by frequently reminding 90 per cent of our pupils that they are not scholars? True, they are not following the single path which all are supposed to follow. But if, instead, we could as frequently show our pleasure in their development along other lines, we might in the long run secure more progress along the traditional lines. Marks cannot well be abolished. Employers want to know how a student ranks. If a limited number of scholarships are available, those who are responsible for granting the scholarships want carefully collected evidence combined into some sort of rating, according to which the applicants may be compared. Students themselves, as a part of their planning, have need of such information, so that they may choose wisely, in part on the basis of the competition such choices would entail. Marks can serve these purposes but they will be peripheral as compared with the fuller evaluation involved in individualization.

Promotion

For the same reasons, our thinking concerning grade designation, promotion, and nonpromotion will need critical examination. Already the concept of the graded school is realized to be chiefly a rough classification of pupils according to age. What modifications will be needed will have to be discovered in pioneering schools. It has been said above that there must be enough flexibility of organization to permit the experimentation. Promotion and failure are ideas appropriate to a previous period in public education when only one line of development was offered, and that only for the few who could make good progress along that line. It still had meaning when all pupils were to be served, but when "adaptation to individual differences" involved only a sorting in the effort to remove the differences. Today it is expected that the school nourish the development of each child, and it is increasingly expected, as already indicated, that that development embrace far more than knowledge. With the children of the community developing in a healthy manner toward their unique patterns of maturity, what will "grade" mean? And if "grade" loses its meaning what will "promotion" and "nonpromotion" mean? As incentives, children need the pleasures and satisfactions which intimately and inherently follow their efforts, not adult judgments which are made once a year. The success that contributes in an important way in the process of development is the success of any task well done, any problem solved, any meaning discovered. They need failures too, but little ones commensurate with their immature undertakings. Failure is good motivation only so long as it provokes greater or better effort. Faith may not be placed in the mechanics of grouping and promotion to achieve these values. It is difficult to conceive of the use of success and failure as less productive of good learning than in the form of a severe judgment on a year of a child's life.

Mental Hygiene

Will this shift in the definition of educational objectives require the inclusion of a mental hygiene program? That depends upon how the term is defined.

The mental hygiene movement began as an effort to improve the care of those suffering from mental disorders serious enough to require hospitalization. Gradually it has become preventive in its emphasis. But it can become preventive and still fall far short of being a satisfactorily positive educational program of personality development. So long as educators think of a preventive mental hygiene program as the early identification of prospective hospital patients and their treatment as if diseased, the situation is seriously short of being satisfactory. What is needed is *not* identification of cases for therapy. What is more unhygienic than for teachers to search their classes for pupils who are thought to be on their way to a later need for hospitalization? We have had a negative approach to mental hygiene long enough. If the character, citizenship, and adjustment objectives are raised above the knowledge objective, we will have attacked the cause instead of the symptoms of an educational inefficiency. The need is for an individualized effort in the area of personality development and adjustment.

What then is the place of mental hygiene in this improved educational effort? A mental hygiene emphasis upon the identification of a few needy cases and upon therapeutic measures in these cases is much too negative. It must give way in education to a more positive program. Education is not therapy. The need is not for a mental hygiene program but for a hygienic educational program.

The Administrator

If character, democratic citizenship, personality adjustment, and the habit of self-improvement are to be the supreme objectives, then the present tendency toward authoritarian administration and organization of education needs to be modified along the lines indicated. But to inaugurate these modifications merely by issuing an order is not to promote development most efficiently. Changes can and should be made only with the growth of agreement as to the need on the part of all concerned.

Conditions for learning are not optimal in a school in which the parties are driver and driven. Friendly cooperation must characterize the relationships. By those who think it cannot be done, this is understood as meaning simply a relaxation of discipline. But what is needed is not a school without discipline; it is one in which cooperation and self-discipline are developed.

Clearly this cannot come along if it involves only the proper pupil-teacher relationships. The requisite beliefs, attitudes, and efforts must be community-wide. Parents, board of education, superintendent, supervisors, principals, all must cooperate in the effort. Without a considerable amount of agreement about the values sought, the teacher can do very little. The teacher must not feel insecure because he is departing from the more traditional procedures. Nor, if he is capable of directing along untried lines, must he be made insecure by the lack of sympathetic support.

Assistance must become the characteristic of the organization and administration of such a program. This is asking a lot of the administration. Administration of education traditionally took its cue from industry. The administrator felt that he was successful to the extent that he planned all phases of the work and provided for its smooth execution. It is not easy for him to take a different role. But in the school, organization and administration must wait on and serve the activities which are most educational. A lot of on-the-spot planning is necessary. The superintendent must become the teachers' and the pupils' helper. Without his help they cannot follow the course which is most educational. The organization must be flexible and functional. Although helper in this sense, the superintendent at the same time should direct the development of his teachers and his community in the same spirit in which his teachers encourage and stimulate development among their pupils. He cannot lead in the discovery of a better education if he is a defeatist. Progress does not come at the hands of those who see only the hazards and difficulties. Many feel that any modifications involving a more individualized procedure are impossible with the present pupil-teacher ratio. Too little is known about the possibilities to say with any certainty that it cannot be done. The use of pictures, recordings, and radio for such portions of the program as defensibly could be carried on in large groups might release a great deal of teacher time for a more individualized guidance. And who knows what changes would be brought about by an honest effort to develop pupils for responsible self-direction?

And Finally, Teacher Education

What the teacher needs most of all during his training period, in order to be well prepared to participate in the mutually cooperative educational program which has been suggested above, is experience in such a program. This sounds trite enough but has two meanings, both important. In the first place, the future teacher's collegiate program must embody all the characteristics which have been suggested above, and in the second place, the teacher-to-be should have a liberal amount of work experience. A higher-education experience beyond a public-school period, in both of which responsible self-direction was developed, would in itself be a better preparation for the direction of learning than is had today.

In conclusion, the reader is assured that to have emphasized the neglected character and adjustment objectives is not to have denied the importance of knowledge. No one would deny this importance. Some of the teachers in training will need all the mastery of the various specialized areas of knowledge they can get. The traditional knowledge objective of the school has been neglected only because the effort in this chapter has been confined to a consideration of more efficient learning in the less traditional areas.

To describe here the attitudes, habits, interests, and understandings concerning learning and its direction which should be acquired as a part of teacher preparation would be to repeat the entire discussion. In other words, the psychological observations mentioned below as important have been already presented and are repeated here merely for emphasis.

1. Strictly speaking we cannot separate man's personality into the aspects for which heredity is responsible and those for which environment is responsible. When we speak of hereditary or environmental traits we would be speaking more correctly if we spoke of traits, the development of which is little or much within our control.
2. Much more than is commonly realized, the development of character, personality, and ability traits is controllable. The moral is to beware of the rationalization of educational irresponsibility on the grounds, "It's his nature," or, "The child's growth and development are natural processes,"
3. There is no easy way to know as much about a pupil as teachers need to know. The sorting of people into a few categories or types is an oversimplification of the problem which faces the teacher. Test scores are of some value, but like typing habits, they may do more harm than good. For instance, harm has been done by thinking that the I.Q. alone is an adequate description of a child's ability. By getting the impression that a little information is adequate, the teacher is prevented from seeking a fuller and a more valid knowledge. If teachers are to know their pupils as they need to know them, they must develop the habits and skills involved in objective observation, sampling, and interpretation.
4. The most important thing for a teacher to get from psychology is an understanding of, and control over the learning process. More teachers in preparation should specialize in an understanding of the learning process. It is from those who bring this interest and understanding to the work of the school that leadership is to be expected in the greater individualization of education.
5. Learning may be thought of as the profit which accrues from an experience. In other words, learning is being able after the experience to do approximately the same thing with less help. After the learning experience, cues alone, without the other supporting helps, are adequate.
6. It is the novelty of experience which provides for learning, not repetition. Hence, the remedy for poor progress is not

more of the same experience, but experiences better designed to provide the desired learning.

7. Learning is not in its essential nature a slow and difficult process. It is slow only in its late stages. In its early stages and when it takes place under optimum conditions it takes place swiftly. Many important learnings are the result of single experiences. When progress is slow in the early stages it is because control or teaching is difficult. It is often very difficult to arrange for the learner to have the experience from which the desired learning must come. It is difficult under any conditions not to mention optimum conditions.
8. Mutual interference between experiences minimizes learning. The situations in which this is particularly true may be recognized as those in which there are conflicting claims upon attention.
9. Whether or not a given feature will acquire cue properties in the course of an experience depends upon the extent to which that feature is focal in the experience. We are often disappointed in the outcome of what we thought was a good learning experience, because the learner's attention was not where we thought it was.
10. An understanding of the relation of attention to learning is also an understanding of the key concepts of "meaning," "problem solving," "the creative act," "insight," and "intelligence."
11. Motivation has very important bearings upon learning. Learning occurs in accordance with the influence of the factors referred to above, but motivation usually exercises an important control over those factors.
    a. Many interests mean much activity, more novelty of experience and hence more learning.
    b. Interests are very influential in determining what will be focally experienced.
12. The teacher should take these observations, or a list of such others as seem more valid, as working hypotheses to be modified as need is indicated in the course of experience and of further study.

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